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# ELECTRONICS Australia

OCTOBER, 1973

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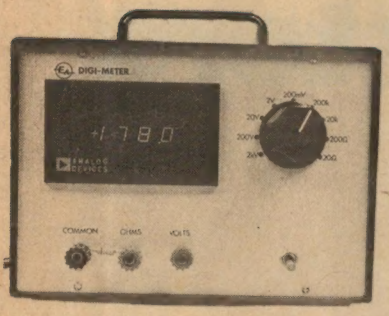
# ELECTRONICS Australia

Australia's largest-selling electronics & hi-fi magazine

VOLUME 35 No 7

Building this digital volt-ohm meter is a lot easier than you'd think. See page 30.

The pickup in this new record player goes around, while the record stays still. It's ideal for education and training, as our story on p24 explains.

This is a historic issue, and one which gives you, the reader, a very worthwhile bonus. Inside you will find a complete 64-page component catalogue / data manual, published by arrangement with Dick Smith Electronics Pty Ltd. It's free, offered with their compliments and ours.

## On the cover

Assembling hi-fi amplifiers, radio receivers and other electronic projects is a very rewarding hobby, and one which is enjoyed by many hundreds of thousands of people throughout the world. Our picture shows Sydney enthusiast Robin Cooper unpacking a kit of parts for our own very popular "Playmaster 136" stereo amplifier project, watched by his sons Nick and Jeremy.

## CONTENTS — OCTOBER 1973

### world of electronics and hi-fi



### projects and technical



### regular features

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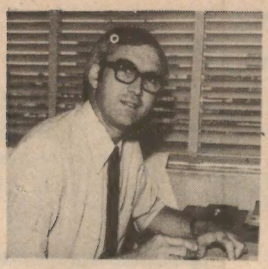

# EDITORIAL VIEWPOINT

## *The FM broadcasting controversy*

In their recent interim report on broadcasting and television, the Senate select committee on Education and the Arts recommended that a further independent inquiry be carried out into the controversial question of FM broadcasting for Australia. They recommend a thorough re-examination not just of the technical aspects, but of the social and economic policy aspects as well. Reactions to the report seem to confirm that there are three main groups of people involved in the controversy.

One group is basically pro-ABCB, and argues that Australia will have to go to the UHF band in order to have a reliable, flexible and forward-looking FM broadcasting system. Backing up this view is the weight of evidence produced by the Australian Broadcasting Control Board, which is as yet the only body to have carried out extensive technical investigations into the matter from both the theoretical and practical aspects.

Almost diametrically opposed to this group are those who want a VHF FM service, generally either because they already have equipment capable of receiving VHF, or because they are concerned regarding the possible delay and/or cost penalty which may be associated with the establishment of a UHF service. Broadly speaking, this group cannot marshal the weight of practical technical evidence behind the first group, but tends to fall back mainly on theory and analogy.

Somewhat less emotionally involved in the controversy than either of these groups are those who believe, as I do, that quite apart from the technical considerations not enough thought has yet been given to the broad areas of economic and social policy. The continuing controversy itself seems to offer sufficient evidence for this belief.

Regardless of one's individual position, probably the only criticism one could reasonably level at the Senate committee's recommendation for a further inquiry is that it will cause delay. Against this must be weighed the potential value of an inquiry, which could be great. Hopefully it would establish not only whether Australia can justify an FM broadcasting system in economic and social terms, but also whether the technical choice of spectrum allocation by the ABCB was a valid one.

Both questions are surely of great importance to all Australians, if only to the extent that FM broadcasting will probably involve a great deal of public money.

*— Jamieson Rowe*


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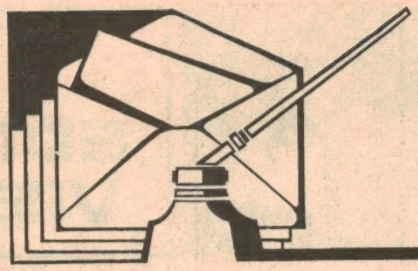


# LETTERS TO THE EDITOR

The views expressed by correspondents are their own and are not necessarily endorsed by the editorial staff of "Electronics Australia". The Editor reserves the right to select letters on the basis of their potential interest to readers and to abbreviate their contents where this appears to be appropriate.

## TV Definition

It was interesting to read about the early television systems (EA, August) and in particular the 240-line system developed by Baird in 1936. In case anyone should doubt the effectiveness of such low definition, it is worth reflecting that today many Australians are watching a picture of some 300 lines, apparently without complaint.

To illustrate this, I should explain that I am the owner of a current model 12in portable television receiver. After purchase I discovered that the raster would not interlace. I don't mean simply that the lines were paired, but that there was a total lack of interlace of any kind. Since then I have been forced to view a picture containing only 300 active lines.

I phoned the company's service department who told me that none of these TV's would interlace. They were quite right, too, because I have since checked a number of these sets on display in the shops, and they all perform the same.

It seems rather ironic that many people today must watch a picture containing only 60 more lines than they would have in 1936, which is poor reflection upon Australia's leaders in communications.

J. M. Winsor (Chatswood, NSW.)

**COMMENT: Our impression is that few portable TV receivers interlace properly because of the proximity of the deflection circuitry and sync separator. Manufacturers contend that, on a small screen and at any likely viewing distance, the difference is not discernable.**

## School Musical

I thought you might be interested in an unusual "spin-off" from one of your record reviews. Some months ago you reviewed Word Inc's recording of "Lightshine" by Buryl Red and this caught my eye in my regular reading of EA.

In The Berkeley High School we have a tradition of a musical production each year. We've done the gamut: G&S, "Reedy River", "The Sentimental Bloke" and so on, but we needed a change of pace and style. Your review suggested a possible new approach and we sent for the record.

It was an immediate success. For the first time in my experience, we didn't have to beat the bushes for people to join the cast and we had streams of students turning up for the auditions.

Word Inc were able to supply an accompaniment tape with the same group as on the LP and some keen pop fan identified Elvis Presley's drummer on it. We are using this on an Akai M10 to overcome the difficulty of gathering a local musical group sufficiently talented.

The script we completely rewrote to give a little more bite and topicality, eg "Mercy" now speaks and acts like Paul Hogan.

Thank you for introducing us to the music.

G. Cohen (Berkeley High School).

**COMMENT: By coincidence we mentioned your letter to a drama teacher from Queensland who also happened to be looking for something different. We would judge that "Lightshine" will be making its debut, in due course, up amongst the bananas. (To anticipate the questions, it was reviewed in our March 1973 issue and is available from Sacred Productions Aust, 181 Clarence St, Sydney 2001.)**

## Observations on CDI

May I add one or two more comments to the correspondence that already exists on the subject of CDI. I have read the June 1973 article by Leo Simpson, and would agree with most of what he has to say. I have myself made a CDI ignition system which I have fitted to two vehicles, namely a Humber Snipe, followed by a Rover 3 Litre.

In both cases the system worked as advertised, and has given me no trouble whatsoever. Starting and fuel economy are both marginally better, pick up is smoother, and if required, high speed misfire is eliminated.

But, and here the "but" is important, great care is necessary with manufacture and mounting of the unit, and with the layout of the HT leads to the plugs. I think this is why the car manufacturers have not given the system much support, so far.

I myself have worked as an engineer in the design department of a large UK vehicle manufacturer for a year, and I know quite well the mentality of the engineers when it comes to fitting new and relatively untried systems to their products.

If, as is the case here, reliability is of paramount importance, and this reliability is only to be obtained with greater cost and time, then he will not elect to take this course, even though the end result would be an improvement. So really the question of manufacturers not opting for CDI, is not one of reliability, but rather of cost required to achieve that reliability.

As things stand now, Chrysler find it cheaper to achieve the required reliability for their improved ignition system by opting for the transistor switching method, although they would, I feel sure, admit that CDI would be, in theory, the better system.

Now to this question of cross-fire which Leo Simpson very wisely brought up. If a CDI, or other high voltage system, is used, then it is ESSENTIAL to separate the HT leads so that (1) they run separately from the distributor to the plug. (2) where they do cross over, then they do so at right angles to

each other.

On both the vehicles to which I have fitted the system, I have had to take great care over the HT routing.

And now one final point, Mr Simpson mentions the troubles with cross-fire on V8 engines. I feel that a point of information is necessary here.

Cross-fire in V8 engines due to the stray capacitance of the HT leads, is no more a problem than with any other engine. The trouble with V8 engines is the closer spacing in the distributor head, of the electrodes combined with the action of the advance and retard mechanisms. This often gives rise to cross-fire whether CDI is fitted or not.

The fitting of CDI to a V8 engine, keeping the spark plug gaps to standard, should not increase the dangers of cross-fire so long as the HT leads are separated as mentioned earlier.

And regarding transistor failure, keep that box cool.

Yours faithfully,
A. G. B. Binnie. B.Sc (Hons)

## Shocking situation

I recently purchased a low-priced Japanese signal generator from a well-known Sydney retailer.

The unit, as supplied, had a two wire power lead and a non-standard plug. The chassis was not earthed.

Fortunately, I decided to replace the lead supplied with a 3-core flex. On removing the chassis I found that one of the 240V mains leads was touching the metal chassis at the fuse holder.

Had I fitted a 3-pin plug and switched on without checking further, I would have had a fifty / fifty chance of picking up a very live signal generator!

H.P. Robinson (Cootamundra, NSW.)

## Coherers and all that

Your recent story about Gil Miles reminds me of some of my earlier exploits in which you may be interested.

During May 1917, whilst a student in Toowoomba, Queensland, I built a spark transmitter and coherer receiver and transmitted morse over a distance of about ¼ mile. The coherer consisted of a glass tube plugged at both ends and containing (I think) finely divided silver. The passage of RF through the tube caused the silver to "cohere," thus reducing the DC resistance and ringing a bell.

The hammer of the bell tapped the coherer so that, on cessation of the RF, the resistance would rise again. This detection pre-dated the catswhisjer.

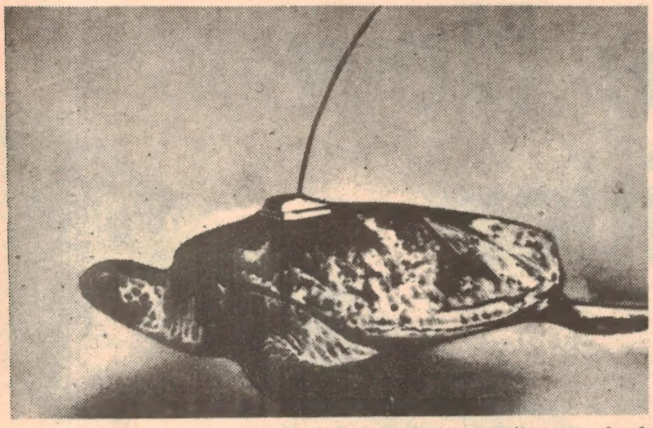
I obtained the above mentioned date from an old diary entry, and also have a photo of some the equipment showing the coherer circuits sketched in the background.

Though the proud possessor of Amateur Operator's Certificate of Proficiency No 1, dated 22nd September 1924, I am still active in electronics having recently assembled a playmaster 132 which performed to specifications since first lining up and switching on.

One of these days I might re-create the old receiver. The transmitter, however, is another matter. If someone were tempted to press the key she would traverse so many non linearities around Sydney and suburbs as to give the radio inspector exceptional cause for alarm.

H. K. R. Thomas (Ryde, NSW)

## ELECTRONICS ARE GOING PLACES



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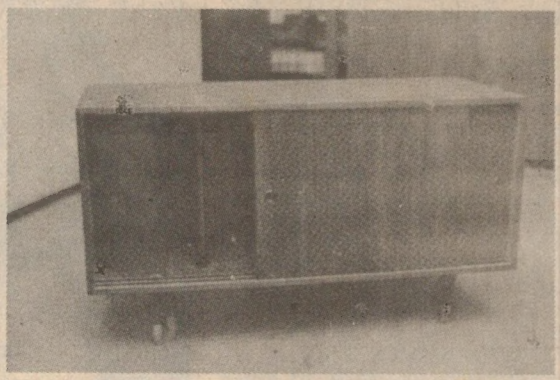
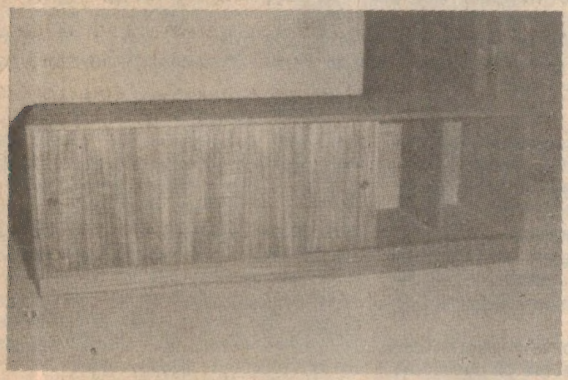
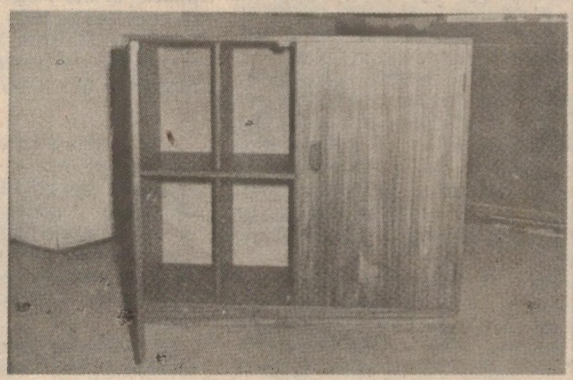
**MODEL RS No. 1**
A neat general purpose unit, designed to carry between 80 and 100 records, it measures 23¾" x 14" (high) x 14½" (deep). Kit price is $29.50 (teak or walnut veneer). Normally comes with base, but 4½" legs optional.



**MODEL RS No. 2**
A larger unit measuring 35½" x 14" (high) x 15¾" (deep), the kit is priced at $45.00 (teak or walnut veneer). Normally comes with base, but 4½" legs optional.



**MODEL RS No. 3**
This model measures 51¼" x 14" (high) x 15¾" (deep) and is priced at $49.50 (teak or walnut kits). Normally comes with base, but 4½" legs optional.



**MODEL RS No. 4**
This attractive model is aesthetically styled with full height opening doors and recessed handles cut from solid teak. With two record storage shelves, one on top of the other, and ample vertical dividers, the unit measures 35¾" x 31½" (high) x 16" (deep). Kit price is $65.00 (teak or walnut veneer).

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# NEWS HIGHLIGHTS

## Rechargeable cardiac pacemaker

Scientists and doctors at The Johns Hopkins University Applied Physics Laboratory recently held the first public demonstration of their new heart pacemaker which is both long lasting and much smaller than conventional units. The new pacemaker uses electrical and electronic components first designed by NASA for use in spacecraft.

Previous pacemakers had several drawbacks. Patients using them faced surgery and hospitalisation about every two years to replace their pacemakers, primarily because of battery failure. The comparatively large size and weight of conventional units caused many patients discomfort and prevented hiding the device cosmetically in the patient's body. The new rechargeable pacemaker system solves these and other problems, according to scientists at Johns Hopkins.

Under development for nearly six years as part of a biomedical engineering program at Hopkins Applied Physics Laboratory, the new unit, employing technology adapted from NASA's space programs, is smaller in size and lighter in weight. It permits easier and faster implants than other devices in clinical use.

The rechargeable cardiac pacemaker was developed under the technical direction of Robert E. Fischell, physicist of the Applied Physics Laboratory, in collaboration with Dr Kenneth B. Lewis, cardiologist of The Johns Hopkins School of Medicine. The testing program spanned six years, including three and one-half years of testing in animals.

Evaluation of the new pacer in patients was undertaken early this year with the first implant last February at the Johns Hopkins Hospital. Since that time, the program has expanded to other medical centres in the United States.

The pacemaker is implanted in the same manner as predecessor units — usually under the skin in the upper left or upper right portion of the chest, or sometimes in the abdomen.

Because of its small size (approximately one-third the volume, one-half the weight, and one-half the thickness of other pacemakers available), the rechargeable pacer is virtually hidden within the patient's body. The new unit is encased in a body-compatible, hermetically sealed, metal enclosure, which keeps body fluids from entering the device to compromise performance, reliability, or longevity.

Some conventional pacers implanted in humans have stopped operating during exposure to electrical interference sources such as microwave ovens, car ignitions and radars. The Hopkins pacemaker is immune to electrical interference and does not turn off even when placed inside an operating microwave oven.

*Shown at left is the new rechargable heart pacer developed at the Johns Hopkins Applied Physics Laboratory. The external charging head is shown in the left hand, whilst the right hand is holding the flat, compact heart pacer. At right, Mrs Helen Chambers, 76, reads while recharging the power cell of her implanted cardiac pacer. The charging head is shown attached to Mrs Chamber's chest.*

The pacemaker incorporates a modified version of space satellite power cells, specially designed for implant in the body. The basic concept for this cell has been proven in more than 10 years of space use. This version has undergone nearly four years of actual tests in pacemakers and the equivalent of 25 years in accelerated life tests.

Because the pacemaker is rechargeable and has a power cell circuit which could last for many decades, extensive and unprecedented testing was directed toward achieving exceptional reliability. The pacer's extended life required the development of a new lead wire to match its longevity. The lead wire incorporates other features which offer the physician an easier implant without requiring loose parts or tools.

Recharging is performed by the patient, using a portable charging console. By placing a small charging head (held over the pacer on a vest worn by the patient) charging energy is safely transmitted without sensation, through human tissues, charging the cell of the implanted pacemaker. The pacemaker transmits a green light signal to indicate to the patient that the charger and pacer are functioning properly.

If the pacemaker is not being properly charged, a flashing yellow light appears and a warning buzz sounds on the charging console. Charging is automatic. When charging is complete, a "blue" light and continuous audible tone advise the patient.

"All of our patients are charging their pacers at home and have found the procedure simple and reassuring," Dr Lewis said. "A weekly charge cycle of 90 minutes is recommended, but the pacer stores enough energy to last about eight weeks. The patient need not be concerned if he misses a week or so, since he can make up the skipped charges later."

The development of the rechargeable pacemaker was supported by institutional research grants from Baltimore City Hospitals, the Johns Hopkins University of Medicine, NASA, the Heart Association of Maryland, G. D. Searle and Company, and by private contributions. Pacesetter Systems, Inc, Sylmar, Calif, has been licensed to manufacture and market the pacemaker.

"This pacemaker is an excellent example of how spin-offs from NASA's space programs contribute to the betterment of mankind," Donald Friedman, Space Technology Utilisation Officer at NASA's Goddard Space Flight Centre said.

The new rechargeable pacemaker system has no life-limiting components, no radioactive emissions and is virtually immune from outside interference sources, supplying safe and reliable long-life pacing. Coupled with its small size, these features assure the patient his pacer is functional, avoiding many problems faced by earlier devices.

# Acousto-optic laser deflector

A research team at RCA Laboratories in Princeton, New Jersey, have developed a highly efficient acousto-optic deflector for laser beams. The new scanner is an anistropic Bragg device constructed from a crystal of paratellurite ($TeO_2$). It operates in the frequency range of 35 to 100MHz, dissipates 50mW, and occupies a volume of only ½cc.

Development of the new device has enabled RCA to produce a laser-beam scanner operating at TV rates and producing a picture resolution three to four times better than conventional TV. In the horizontal direction, the crystal driven laser can easily scan up to the 15,750 lines per second of conventional TV. A retrace time of 10us limits the scan rate. The beam is directed vertically by a conventional galvanometer-driven oscillating mirror.

In developing the deflectors, RCA research scientists were able to overcome the severe dips in efficiency at the mid-frequency ranges that had troubled earlier work with anistropic deflectors. This was done by producing high-purity material and by using a cold-press bonding technique for attaching transducers to the $TeO_2$crystals. As a result, the deflectors have efficiencies, when operating at television rates, of as high as 90 per cent.

Because it does not require the beam-steering mechanism of other crystal deflectors, the new deflector can be fabricated with relative ease. Furthermore, a resolution in excess of 1,000 TV lines can be achieved with a deflector having an aperture of only 0.5cm.

The new tellurium-dioxide crystal scanner is much cheaper and considerably more compact than the electromechanical systems employing rotating and oscillating components. RCA predict that the new scanner could be applied in both image-generating and recording systems using lasers, and that it could eventually replace the conventional electromechanical systems.

# New Honeywell processor

A systems check-out engineer inspects an "EIS" (Extended Instruction Set) processor — the heart of a computer system — during the manufacture of a Honeywell Series 6,000 large-scale computer at Honeywell's Newhouse plant in Lanarkshire, Scotland. The processor orientates some of the models in the Series 6,000 computer systems, including the new model 6,025 computer (also made in Scotland), to business applications.

The EIS unit, worth about 1 million, has been installed at Newhouse to act as a test cell for the start of the Series 6,000 production. Work is well advanced at the Newhouse plant on the 3 million investment program for the new computer systems. Two out of three of the company's computer systems manufactured in Britain are exported.

# Laser generates voltage pulses

Research scientists at the IBM Thomas J. Watson Research Centre in New York have discovered that when the surface of a thin metal film, such as molybdenum or tungsten, is irradiated with short laser light pulses, voltage pulses of up to a twentieth of a volt are generated in the plane of the film. A radiated incident power of about 1kW is required.

The planar characteristics of the voltage pulses enables them to be easily extracted by using simple connections to the surface of the film.

The new phenomenon was discovered during research into heat conductivity. A pulsed laser was used to inject bursts of thermal energy into small samples of various materials, and the results monitored. The voltage pulses appear to be related to the temperature gradient through the depth of the film. However, the pulses are in the plane of the film, which is normal to the temperature gradient.

One interesting feature of the new discovery is that if the film, with fixed contacts, is rotated in its own plane about the axis of the laser beam the polarity remains the same. The polarity can only be reversed by irradiating the opposite side of the film. It is also interesting to note that the performance of this device improves with increasing temperature. Furthermore, the films are responsive to wavelengths from blue to red in the visible spectrum, and also out to the infrared.

Exploitation of the new technique could result in inexpensive arrays of fast photodetectors responsive over a broad optical spectrum and operable over a wide temperature range. In contrast to silicon-based devices, detectors based on the new effect are not subject to heat degradation characteristics. Some experimental detectors have, in fact, demonstrated an increase in sensitivity with increasing temperature.

# Radar reveals craters on Venus

Radar observations made from the Goldstone Tracking Station in California, have revealed the existence of large, shallow craters in the near equatorial zone of Venus. The studies were performed by a team of radar astronomers under the direction of Dr Richard A. Goldstein of the Jet Propulsion Laboratory (JPL). JPL is operated by the California Institute of Technology under contract from NASA.

The discovery was made by using high-intensity radar beams to pierce the heavy Venusian clouds, which completely cover the planet. This latter fact has thus far prevented optical astronomers from examining the surface of Venus.

The Goldstone installation employs a 400kW transmitter operating at a frequency of 2.388GHz, a 64 metre antenna, and a 26 metre antenna. Signals are transmitted by the 64 metre antenna and the return signals are received by both antennas. This enables the system to be used as an interferometer which results in a resolution of about 10 kilometres.

Signal echoes picked up by the sensitive receiving antennas are analysed for time in flight, polarisation, and changes in frequency. Unpolarised signal returns are indicative of rough terrain, whereas polarised returns indicate smooth surfaces. Frequency changes in the radar returns (the Doppler shift) are caused by the rotation of Venus.

Based on a series of observations performed on June 20, 1972, JPL scientists have managed to map an area of 1.3 million square kilometres of the surface of Venus. By utilising the latest digital processing techniques and two hydrogen maser clocks (accurate to one second in one million years), elevation accuracies of the order of 200 metres have been obtained. The radar map reveals the existence of many large craters, some up to 160 kilometres in diameter. However, these craters are not very deep; the largest crater has a depth of only 400 metres.

Further JPL radar scans of Venus are planned to coincide with photographic work of the planet to be carried out by the Mariner 10 spacecraft. Although the spacecraft's TV cameras may not be lucky enough to find holes in the Venus cloud curtain, the radar observations from earth should be helpful in interpreting any data received from the spacecraft.

Another radar experiment will be attempted as Mariner 10 approaches Mercury. A previous JPL radar scan of Mercury conducted in 1969 was successful in delineating some elevation differences in spite of the difficult target afforded by the planet.

The JPL radar studies are performed for NASA to increase knowledge of the planets prior to further exploration. The studies also contribute to the improvement of communication techniques to support planetary spacecraft missions.

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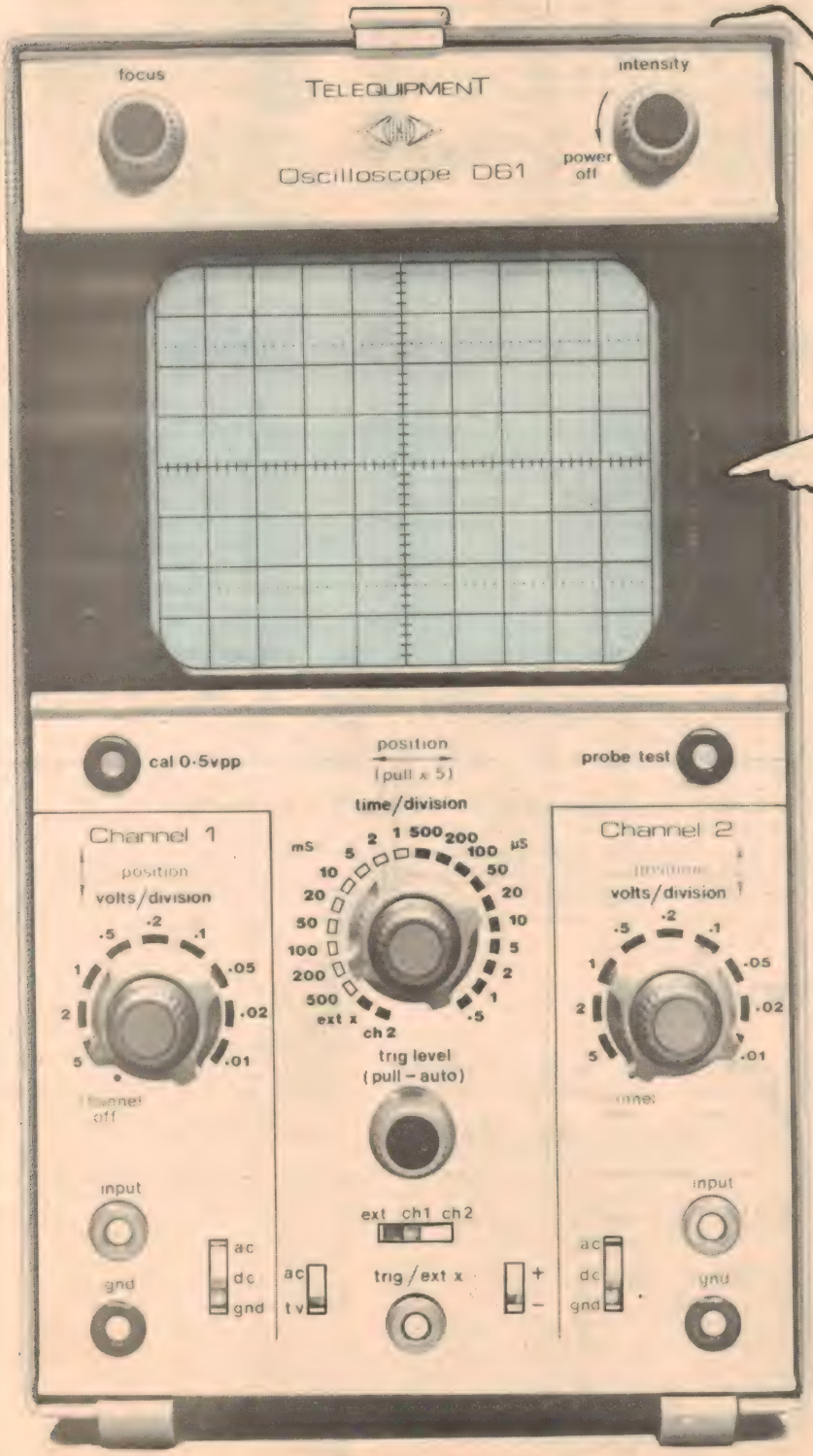


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TX/4

# NEWS

## AWA-Interdata computer agreement

During the past six months Amalgamated Wireless (Australasia) Ltd has been involved in extensive discussions with the Government, Interdata Inc, Oceanport, New Jersey, and their agent, Datronics Systems Pty Ltd, to explore the feasibility of manufacturing computers in Australia. This has resulted in offers being made to Government which are now under examination.

AWA's potential partner, Interdata, has operated in Australia for approximately two years and has sold about 17 systems worth about $800,000. It would want orders for another 17 systems to bring its total sales to more than $1.5 million to make worthwhile a go-ahead for a computer plant in co-operation with AWA's data systems division.

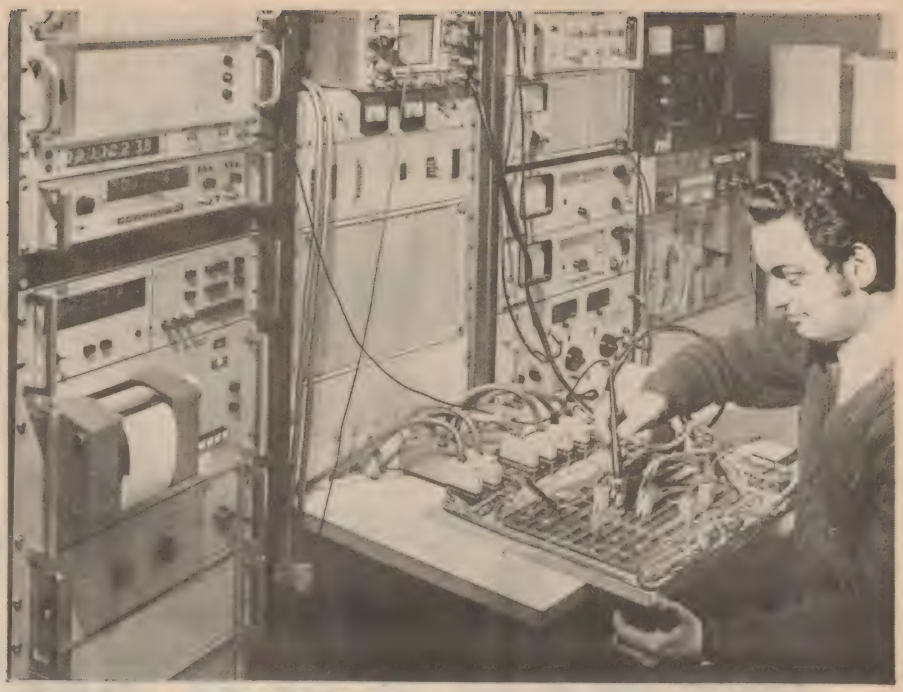
AWA's approach emphasised that all major aspects of capital resources and manufacturing skills already exist in this country. This will not only ensure that a very high Australian content can be achieved but also makes the establishment of new facilities a costly and unnecessary activity.

In particular, AWA's ability to fill the major role of assembly and test operations, starting from basic components, is unique. Skills have been developed in designing and manufacturing computer controlled terminals of high complexity. These will ensure that high quality assembly procedures and fully automated testing will equal facilities available overseas. Additionally, the design backup available will provide the necessary confidence that Australia can maintain manufacture without critical dependeance on overseas knowhow.

Existing facilities for the manufacture of printed circuit boards and integrated circuit assembly, and testing, will also be able to contribute to the Australian content.

AWA, in conjunction with Interdata, has also examined a carefully phased approach which will allow varying depths of manufacture from final testing to full manufacture, assembly and test. This approach can be used to provide a smooth transition into full manufacture and will minimise the impact of set up and learning costs.

With facilities already in existence, AWA is in a position to commence manufacture at very short notice. Discussions have taken place with senior Interdata staff and confidence has been established on both sides that a viable and competitive operation can be achieved.



*An engineer tests AWA's digital processor board. This board is similar to the processor boards used in the Interdata computers planned for manufacture in Australia.*

## Colour TV training by service organisations

The two major electronics service associations in NSW, the Television & Electronic Services Association (TESA), and the Television & Electronic Technicians Institute (TETIA) have combined to become the major training group for colour TV servicing in NSW.

The first two classes of forty technicians have already qualified and the second group of technicians has commenced. The lecture room is adequately equipped with colour TV sets and the necessary test equipment, and the Lecturer in charge is Mike Petery, who is well known throughout the TV service industry.

A major training problem has hitherto existed in country areas, where no opportunity was available to technicians at all. The Associations have also established a unique system of home study by correspondence, and as practical training is a necessity in this field, have made arrangements for Mike Petery to visit the country branches of the associations every two months and give practical lectures with all necessary equipment.

The home study course will take 12 months but at the end of the course well over 100 technicians trained in colour TV service will be available in country districts of NSW.

## Inductive loop radio paging system

In any large business concern staff communication becomes a problem, particularly with constantly mobile staff such as maintenance engineers. To overcome this problem, the MLC Insurance company has installed a Plessey Hasler Inductive Loop Radio Paging System in their new headquarters building in Melbourne.

The new radio paging system has been designed such that it is not subject to any interference from neighbouring radio paging systems. It enables plant engineers and maintenance staff to be quickly paged no matter what their location in the building may be.

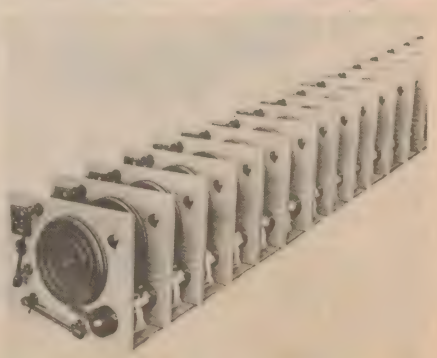
Each mobile staff member carries a small (half the size of a cigarette packet) receiver unit which emits a number of differentiated acoustic signals. Different signals are used to convey different messages, for example: ordinary paging calls, break and entry by unauthorised persons, and the temperature in a part of the building has exceeded a pre-determined level. The device may also be used by staff, who are working late, to contact the security officer with a request to open the building's garage door.

## MBH turntable order

Shown in the photograph are a few of an order of 82 MBH Studio Turntables complete with 2 pick-ups and recording-characteristic compensators.

These were recently supplied to All India Radio, the Indian Government Broadcasting Service, by the manufacturers of MBH equipment, High Fidelity Products, of Homebush West, NSW.

The order is the largest ever placed by All India Radio for turntables and is a follow up of a number of orders for similar equipment by All India Radio from the same firm.



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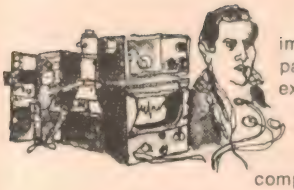

Reliability is an important feature of all component parts — but, when lives and extremely valuable equipment are involved, "absolute reliability" becomes a vital necessity.

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Components from Plessey are tested to the point of destruction and the conditions under which destruction is achieved are carefully tabulated and then checked and re-checked. Research into the means of improvement is undertaken constantly to ensure greater integrity in the component.

Plessey reputation in this field has led to their involvement in most of the major scientific, military and commercial achievements of mankind. New techniques, devices and deterrent weapons are constantly reliant on component parts which demand the ultimate in reliability.

A defective sub-miniature switch or capacitor can cost a jet pilot his life or a manufacturer millions of dollars in lost production and defective goods.

Plessey face a heavy demand from, and a corresponding responsibility to, all fields of industry and endeavour from the aeronautics industries, military and commercial, to medical and electronics concerns.

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APP 66R

# NEWS

## New cables under Parramatta River

Post Office crews recently laid two heavily armoured telephone cables, each about 466 metres long and about 9 tons in weight, across the bed of the Parramatta River in Sydney. The operation, which took precisely five minutes, provided 1,200 new telephone channels between the Ryde and Pitt Street Telephone Exchanges.

Manufactured by Austral Standard Cables Pty Ltd, the 600-pair cables were laid between Huntley's Point on one side of the Parramatta River and Victoria Place, Drummoyne, on the other. The weight of the cables was sufficient to make them sink to the bottom of the river, and to anchor them in the river-bed corridor previously plotted by the NSW Maritime Services Board. The two cables were laid simultaneously and joined to a single 1,200-pair land cable on each bank.

An indication of the extra bulk added to the submarine cables by the layers of waterproofing materials and armour is given by the fact that the diameter of these is 84mm and that of the main land-type cables on the bank is 82mm. Each submarine cable carries only 600 channels, compared to the 1,200 in the smaller diameter land cables.

Low tide was chosen for the laying so that maximum access to each cable end could be obtained and so that there would be no current running which would tend to drag the cable away from its surveyed path during the operation. The cables were anchored to steel pegs driven into the ground at Huntley's Point and laid off large reels fastened to a barge with was towed across to Drummoyne by a tug. A diver completed the day's work by walking across the bed of the Parramatta River to check that the cables had been correctly laid.

This submarine crossing is only one of four required on the junction cable route. The others are at Iron Cove Bridge, Glebe Island and Pyrmont. These latter crossings were scheduled to be carried out in late August and early September, and the whole project is due to be completed by October.

## APO using CATV for training

The use of closed-circuit TV is not new in the Australian Post Office, who have used CCTV systems for staff training as well as for demonstrations. However the use of TV techniques was recently extended into the cable-TV (CATV) area, when training lectures from Adelaide were distributed to Lines staff at regional centres in South Australia more than 300 miles away.

The lectures, introducing a new automatic line fault analysis system, were sent to centres at Ceduna, Whyalla, Port Pirie, Tailem Bend, Bordertown and Mt Gambier. Video went over a broadband bearer network on TV standby, while audio links were set up by conference calls to each centre.

The exercise was very successful, with favourable comments received from all centres on the quality and effectiveness of the technique.

## AWA produces two million colorfones

*AWA's Managing Director, Mr J. A. Hooke (left), the Postmaster-General, Mr Lionel Bowen, MP, and the Director-General, Mr E. F. Lane, watch an operator testing telephone dials at AWA's Ashfield works.*

AWA, contractor to the Australian Post Office for the supply of telephones for more than 40 years, has just manufactured its two millionth Colorfone. The company has also made more than one million telephone dials since May 1969.

Director-General, Mr E. F. Lane, Deputy Director-General, Mr E. Sawkins, and other officers from the APO together with representatives of commercial interests associated with telephone manufacturing were guests of AWA at functions in Sydney and Melbourne to mark the event.

The first company in Australia to manufacture telephones, AWA received its intial APO order in 1933 for 2,500 magneto, central battery and automatic instruments for installation in each of the six States. These telephones were encased in hard phenolic resin moulding, colours being limited to brown or black.

The development of a tough thermoplastic material enabled a large range of colours to be produced. This resulted in the introduction of the Colorfone, one million of which were produced by AWA between 1962 and July 1969.

In addition, the company was awarded a contract in 1970 to supply a new type of wall-telephone in a range of three colours. So far, more than 70,000 of these instruments have been delivered to the APO. Known as the "Wallfone" it is the result of a co-operative effort by the Post Office and AWA.

## NIH shock hazard tester

An automatic shock hazard tester that will cut down the risk of electrical shock to patients connected to electronic monitoring equipment has been developed by the US National Institute of Health (NIH). The new tester is fully portable and may be taken into critical areas such as intensive care units from which electronic patient monitors cannot be removed for servicing. In addition, the unit allows a trained technician to check out a piece of equipment in a matter of seconds.

The tester diagnoses faulty earth wires and excessive current leakage. Operational modes are: current leakage with power off, current leakage with power on (normal and reverse polarity), and resistance to ground (power on and off). All readings are displayed on five digital readouts. A simple recording procedure facilitates interpretation of the data enabling potential hazards to be diagnosed and corrected.

The performance of a particular instrument over a period of time may therefore be carefully monitored. For example, readings taken over a period of time may reveal an increasing current leakage situation, or an increase in resistance to ground. The early correction of such trends ensures that electronic monitoring equipment is maintained in a safe operating condition.

The new tester uses solid-state logic components in a sequencer composed of timing circuits and a counter. The sequencer moves through 30 operating modes, each mode controlling a power circuit for measuring currents and resistances. Two voltage-to-frequency converters and five counters are used for the digital displays. To ensure electrical safety, the tester incorporates a 1kW isolation transformer.

Operation of the tester is quite straightforward, The instrument to be tested is simply plugged into the test unit, which in turn is plugged into the power supply. The earth connection is facilitated by an alligator clip.

The National Institute of Health designed the tester in the hope that it would go into commercial production. As well as ensuring that biomedical instrumentation is kept in a safe operating condition, the unit also provides the technician with a safe means of checking such instrumentation.

# The klystron: born out of necessity

**Like many important inventions, the klystron valve was born in rather inauspicious circumstances. When the Varian brothers produced the first klystron using makeshift equipment in an overcrowded laboratory at Stanford University just before World War 2, probably not even they realised the important part it was to play in radar, microwaves and UHF broadcasting. In this commemorative article, Dr Russell Varian looks back on the discovery and its consequences.**

The origin of the klystron had its roots both in previous experience in television research and in activities in pure physics. From 1930 to 1933 I had been engaged in television research with Philo T. Farnsworth in San Francisco and with Philco Corporation in Philadelphia. Previous to this time there had been an effort on the part of the faculty of the Stanford Physics Department to obtain a high voltage source of X-rays in the order of 2 million volts. This was prior to the financial crash of 1929. While money flowed rather easily at that time, it did not gush for scientific purposes and a budget of something like $35,000, which was estimated to be the cost of using the Ryan High Voltage Laboratory to generate X-rays, was completely unobtainable.

After 1933 I returned to Stanford to continue work for a doctor's degree in physics. Dr W. W. Hansen and I took it upon ourselves to try to find a cheaper method of getting high voltage X-rays than the one previously proposed. We investigated a large number of schemes, all of which looked interesting but too expensive.

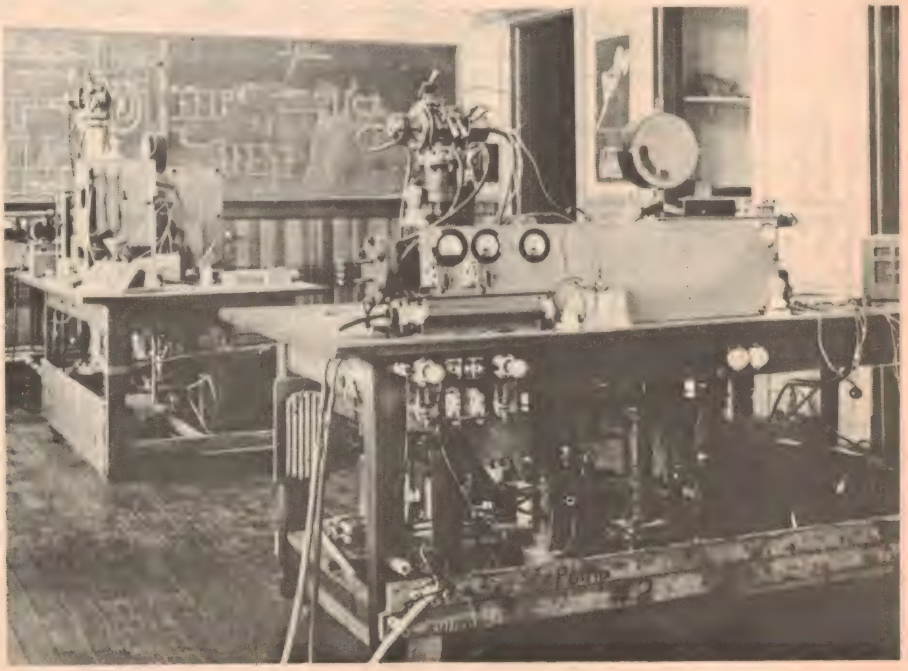
During the period of this work, Hitler's rapid rise to power took place and resulted in many discussions between my brother Sigurd and myself concerning the great danger to the world in general. My brother had a great deal of experience in blind flying with Pan American and was quite sure that he could locate a target and deliver a load of bombs either in bad weather or at night without giving the defenders even one shot at him by any of the existing defence methods. As time went on he became more and more alarmed about the striking power of Hitler's air force and this line of thought led naturally to ideas about what is now radar, an aircraft locator that would be completely independent of visibility conditions.

The frequency required for radar had to be a wavelength which was quite long compared to the diameter of cloud particles or rain drops, and quite short compared to the diameter of beam focusing and projecting equipment of a practical size for use. This inescapably put the required frequencies for radar into the microwave region.

During the time when my brother and I were working, Dr Hansen was continuing his work at Stanford on the question of the most efficient form of resonator. My brother and I finally decided to go to Stanford and start on the project of producing radar. I felt that Hansen's work was a good starting point for a high frequency source which could be used for radar.

One day, after we had thought of a number of schemes, I was occupied in developing a classification for all the schemes we had thought of so that we could systematically investigate them all and not discover later that we had overlooked some of the most promising ones. In the process of developing this classification I suddenly thought of the velocity-grouping principle. From a psychological viewpoint it is rather interesting that this attempt at classification actually produced the invention of the klystron. The velocity-grouping principle did not fit any of the schemes of classification that I had contrived and I rather think that the idea occurred to me because I was unconsciously attempting to test the validity of my classifications. Hence I thought up an exception to the classification which actually turned out to be the basic concept of the klystron.

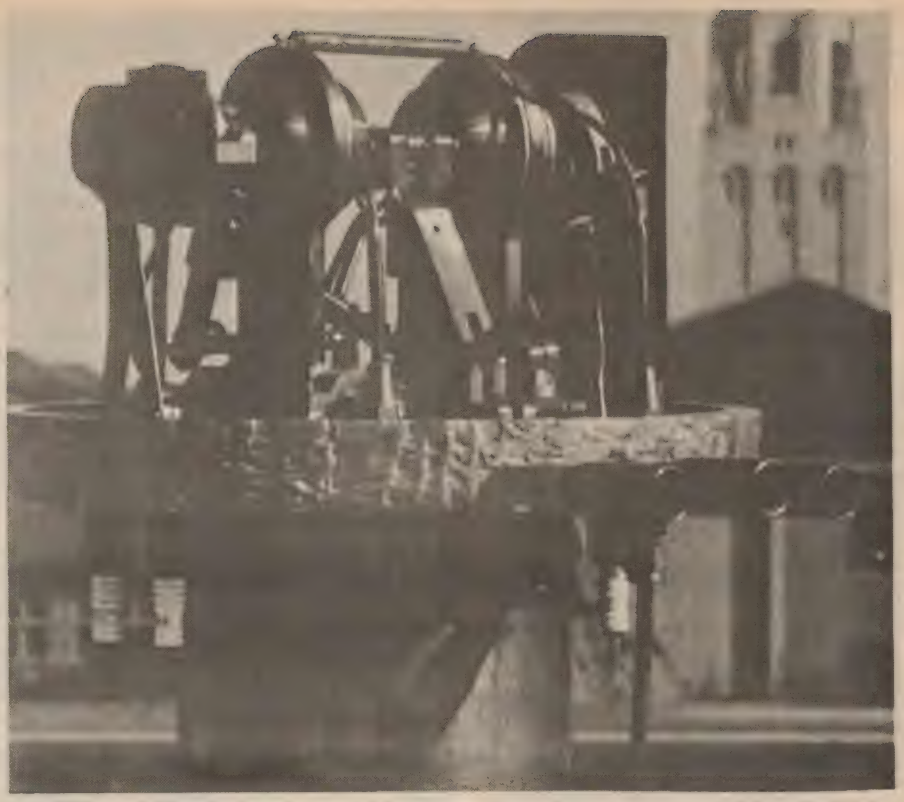
There followed a very extensive series of discussions between Hansen and myself about the applicability of this new idea. After the first few discussions we had pretty well concluded that this new idea was the best of any that we had conceived, and the remainder of the discussions were related to the means for carrying it out.



*Above is Dr Russell Varian, the inventor of the klystron. At right is the laboratory at Stanford University where development work on the klystron took place.*

In the meantime, my brother was impatient and needling us all the time so that he could get into the work by actually building something. Less than two or three weeks after the original idea, we had settled on a design that looked very much like the early klystrons. After deciding what kind of an oscillator to build, there was another important problem — if we build such an oscillator, and if it oscillated at times, how were we going to know that it oscillated?

I finally decided that we could allow a small part of the electron beam used to drive the klystron oscillator to pass through a hole in the last resonator and be deflected into the space beyond by a magnetic field so that it would land in a moderately small area on a fluorescent screen. This would provide a quick and sensitive detection system for any oscillations which occurred. As it turned out, this invention was probably about as important as the klystron invention itself, because without it we probably never would have discovered the oscillations although they would have been occasionally present. The first model we built produced some oscillations which my brother saw on the fluorescent screen, but the tuning mechanism was not capable of going smoothly through resonance and so we were never able to repeat the result. It was about the third model we built which gave reproducible evidence of oscillation.



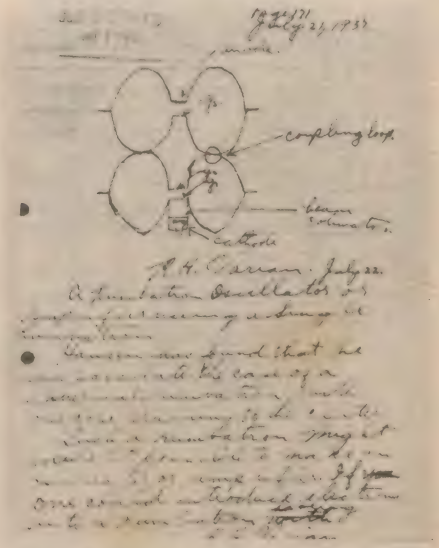
*A model "B" klystron. Note the use of spark plugs as insulators.*

At the beginning of the series of experiments, the university had made an agreement with us and provided the facilities and stock of the machine shop, plus $100 to purchase parts. At the time when we got conclusive proof that the klystron worked, we had spent about $50 of this $100 appropriation. This was probably the cheapest project ever completed in microwaves. About the time we had demonstrated the operability of the klystron, we had exhausted our own financial resources and very quickly had to hunt up some means of support.

My brother made a trip to San Francisco and talked to people in all three branches of the military service. All three branches expressed mild interest in the idea but none showed signs of supply support for further work at a near date. However, a few days later, we had a phone call from the CAA (Civil Aviation Administration) office and we found that a man in the CAA who was concerned with blind landing systems for airplanes had arrived and he was extremely interested in the idea. Also, there was a man from the Sperry Gyroscope Company at CAA who expressed interest in seeing the device and we were asked whether he could come along with the other men.

We were somewhat afraid to disclose the device at this time to a commercial concern but we decided to take the risk since we had to have support rather quickly. The CAA people were quite sure they could get support for this project rather quickly and we were much encouraged. However, much government red tape intervened and it soon became apparent that although there was a great desire among some highly placed personnel in the CAA in support of this project it would take a long time to get the money.

In the meantime, the Sperry Gyroscope Company saw in this device something that would supersede their military searchlights for air defence and therefore they offered to support the project. A klystron had been produced but it remained for others to




*At left, Sigurd and Russell Varian, Professor David Webster, William Hansen and John Woodyard examine an early klystron. Above is an entry from Russell Varian's notebook, July 21, 1937.*

complete the radar system we had contemplated. The project was supported for some time on the Pacific Coast by the Sperry Gyroscope Company but in the fall of 1940 they moved the whole operation to Garden City, Long Island, where we continued to develop the kylstron and related equipment during the war.

When it became apparent that a new breakthrough had been made in the microwave field by the invention of the klystron, my brother and I, as well as the university, naturally were quite anxious to obtain publication. We wrote one letter to the Editor of the Journal of Applied Physics and later a more complete article by Drs. Hansen and Webster was published. We were a little uncertain about who would be helped most by these articles, but as later developments proved, the publication of these articles was a very important factor in winning the war since it was the British who immediately saw the significance and went to work under high pressure to produce klystrons. They had klystrons which were practical for operational use considerably before we in America had them and all of the earlier radars used by the American forces used klystrons which were copies of British models. On the other hand, the Germans did little or nothing about developing the klystron.

When World War II started, the Stanford group was continuing the development of the klystron at Garden City, NY. Included among these were Sig and myself, Dr Edward Ginzton, Dr W. W. Hansen who divided his time between the Massachusetts Institute of Technology and the Sperry Laboratories, Don Snow and Fred Salisbury. Myrl Stearns, who was also a Stanford graduate in Electronics Engineering, joined the laboratory shortly after the move.

Californians seem to always want to return to California. There were also some other forces tending to cause us to look longingly at California. One was a considerable misunderstanding of the requirements for the performance of successful research among the administrators where we were.

As time passed, a group of us began to make plans for what we would do after the war was over. We decided that we would return to California and establish a laboratory of our own. There engineers would have a chance to try out their own ideas about how an engineering business should be run.

Shortly before the end of the war Dr. Hansen returned to Stanford University, largely for health reasons, and Dr Ginzton accepted an appointment in the Physics Department. I returned to California very shortly after V-J Day and began to actively look around for a location for our new laboratory, and for possible items for development and production. Since the laboratory would be quite small and have limited capital I more or less eliminated klystrons from the proposed field of our activity. This was because I thought that in order to compete any company would have to have a considerable number of klystrons, and since I knew that they were quite expensive to develop I did not see any possibility at that time of entering the klystron business.

*The invention of the klystron made possible the development of radar which, of necessity, utilises frequencies in the microwave region. The above photograph shows Russell and Sigurd Varian with experimental microwave apparatus.*

I was very favorably disposed however to select some new development in research that we could continue to develop, and that would preferably grow rather slowly so that we could grow with it. As something meeting these requirements I took a very deep interest in nuclear magnetic resonance which had been developed by Bloch and Hansen at Stanford, and independently by Dr E. M. Purcell and Professor Robert Pound at Harvard.

We started the company with six full time employees, consisting of Fred Salisbury, Don Snow, Myrl Stearns, Sig Varian, my wife, and myself. The entire technical and administrative staff consisted of the five men, and all the business, financial, and stenographic services centred in Dorothy Varian. Our entire capital consisted of about $22,000.

Dr W. W. Hansen and Dr Edward Ginzton were consultants and members of the Board. Also Dr Leonard Schiff of the Stanford Physics Department served as a member of the first Board of Directors.

The size of this start was large compared with the size of the original start with the klystron, but it was still very small in personnel and capital compared to our competitors.

We had one stroke of very good luck in getting the R-1 klystron contract almost at the start of our operations. This was a contract proposal that had not met with any enthusiasm from the manufacturers because it had an arbitrary allowance for overhead which was unrealistically low. However this did not, at that time, bother Varian Associates because Dorothy Varian was our entire labor overhead; the rest of us were engineers.

The company started to grow almost from the start and has continued, except for a couple of minor recessions, from six people and $22,000 to 1300 people and a business in the neighbourhood of $20,000,000 in 1958.

Despite the company's growth we have managed to reconcile the practical requirements of staying alive and providing for growth with the basic concepts and ideals with which we started. Our primary strength lies in the fact that in pursuing these concepts and ideals we were able to recruit an exceptionally capable group of people. The millions of dollars worth of equipment and facilities that we have are very essential to our success, but the real thing that makes Varian go is the people that are in the organisation.

POSTSCRIPT:

Varian Associates has increased ten-fold since Russell Varian penned the foregoing article a little over fifteen years ago. By that time (1958), the company had achieved an annual sales level of $19.5 million. In 1973, it is estimated that Electron Tube and Device Group sales alone will exceed that figure by a multiple of five, and total Varian sales will be approximately $220 million.

The klystron was, of course, the cornerstone from which the company's growth unfolded in those early years, but from that original product line, Varian tube activities soon expanded into production of high power klystrons, travelling wave tubes, magnetrons, backward wave oscillators, gas switching tubes, solid state devices, and a variety of microwave components.

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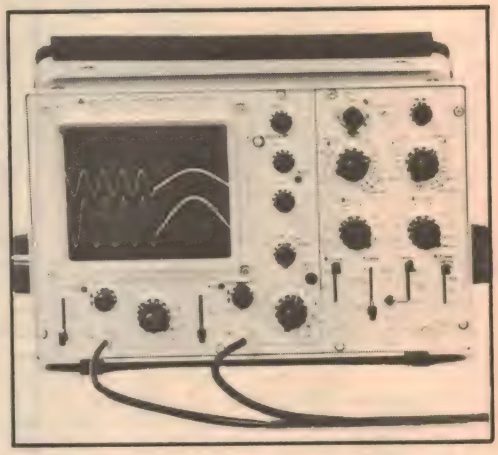
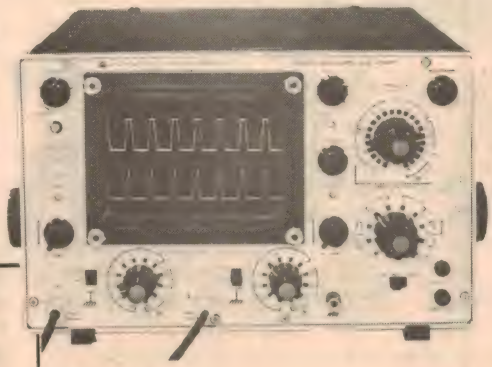


**(Above) OS 250TV.** A 10 MHz dual trace CRO with 10 cm and 8 cm display. Two input channels with max. sensitivity of 5 mV/cm and DC to 10 MHz bandwidth. A low cost CRO that is ideal for colour TV servicing and general lab. work.



**(Left) OS 1000A.** A useful portable 10 cm x 6 cm display CRO for servicing or lab. wide timebase ranges of 1 sec./cm to 0.5 uS/cm in 1-2-5 sequence with accuracy of ± 3%. Comprehensive trigger control with broad bandwidth and calibrated deflection factor.

**(Above) OS 2100 & OS 2200.** Fully modular, 10 cm x 6 cm display, choice of mainframes, 170 uS signal delay, CVT stabilised supply and a full range of plug-ins. The OS 2200 may be used in 3 modes – conventional, variable persistence, and store.

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**(Above) PROBE KIT.** Suits all Advance oscilloscopes. A standard compensated test lead may be terminated at one end with BNC or UHF type connectors and at the probe end probe bodies of x 1 and x 10 ratio. Spring loaded hook, needle, 4 mm play and alligator tips may be fitted to this probe. In plastic wallet.

JM/142-73

# New DVM from H-P is held in the hand

A solid-state, hand-held, digital multimeter, the Model 970A, has been released by Hewlett-Packard. The new device features automatic ranging of AC volts, DC volts and ohms over five ranges, with line-of-sight 3½ digit readout at the point of measurement.

Ideal for field service, on the bench, or in the laboratory, this new completely self-contained pocket-sized Model 970A Digital Multimeter (DMM) from Hewlett-Packard measures AC and DC volts and ohms over five ranges. All electronics, including the display and batteries, are in one small, hand-held package. There is only one function control to set, and only two input terminals to use rather than the usual three to eight.

The Model 970A automatically selects the right range, making it easy to use by technicians, repairmen, telephone craftsmen and engineers. This battery operated probe is the first known hand-held DMM incorporating solid-state auto-ranging technology. All solid-state switching is in its one MOS integrated circuit.

Hewlett-Packard use a five-digit light emitting diode (LED) cluster in their 3½ digit DMM. All probe voltage readings are given in volts and resistance readings are given in kilohms. There are no scales to misinterpret. Decimal point placement is automatic.

Automatic decimal point placement and automatic polarity indication save time. After setting the function selector (AC V, DC V or kohm), the user simply touches the probe tip to the test point, presses the "push-to-read" bar, and the solid-state LED readout automatically displays the correct reading and polarity. When measuring ohms or DC volts, it takes typically less than 2 seconds to range and settle to a proper reading.

Since the display is close to the point of measurement, a user working in closely-packed circuits can hold the probe in one hand and take a measurement without needing to turn his head. The display can even be electronically inverted, thus eliminating the possibility of confusing a 6 for a 9.

DC voltage from 0.1000V full scale to 500V is read to an accuracy of ±(0.7pc of reading + 0.2pc of range). Full scale ranges are 0.1, 1, 10, 100, and 1,000V (500V maximum input).

AC voltages from 1V through to the highest range, (500V RMS maximum) from 45Hz to 1kHz, are read to ±(2pc of reading + 0.5pc of range). Accuracy from 1kHz to 3.5kHz is ±(3pc of reading + 0.5pc of range). On the 0.1V range and below, accuracy from 45Hz to 1kHz is±(2pc of reading + 0.5pc of range). On these same ranges, accuracy from 1kHz to 3.5kHz is ±(5pc of reading + 0.5pc of range).

Resistance measurement accuracy is ±(1.5pc of reading +0.2pc of range). Ohms ranges are 1 kilohm full scale (1 ohm resolution) through to 10 megohms. Maximum test current will not exceed 10mA.

Input resistance on the voltage ranges is 10 megohms. Input capacitance on AC is less than 30pF. On all voltage ranges, the

*Ease of operation of the Model 970A is illustrated above. At right is a close-up view, showing the readout inverting switch.*

**"Taking it all together — performance, features, styling — the BSR 810 moves into ranking place among the best automatics we know of. And at its price, the others may well be in for a real contest." Hi-Fidelity Magazine, May 1972.**


# At $149* for the kit, the brilliant BSR/810 transcription turntable is hardly cheap. But your ears will tell you it's a bargain.

* At recommended retail price.

BSR, manufacturers of most of the world's turntables, have now turned the tables on expensive units.

And here are the features that make the 810 such an attractive proposition: the unit weighs 17 lbs — the diecast turntable alone is a solid, dynamically balanced 7½ lbs. A 4-pole beautifully balanced synchronous motor automatically compensates for any fluctuation in voltage input, or for any record load. A pitch control gives absolute accuracy of speed, utilising a stroboscopic centre plate.

The low mass pick-up arm gyroscopically pivots in a concentric gimbal mount producing virtually friction free movement in both horizontal and vertical planes. It also has a slide-in cartridge carrier, decoupled one piece counterbalance for a minimum tracking pressure of ¼ gramme with suitable cartridge. And the arm length is over 8½ inches to reduce tracking error to less than 0.5° per inch.

Viscous cueing is also standard on automatic as well as manual operation, and a unique anti-skate device is also featured for elliptical and standard styli. Speeds are 33⅓ rpm and 45 rpm. (Which are all you need today.)

Single to automatic play conversion is achieved with the interchangeable umbrella centre spindle.

Start-stop, record size control and auto repeat and manual conversion are actuated by push button controls set in a handsome brushed aluminium panel.

Of course there is much more you'll want to know about the BSR 810. Write to BSR and we'll send you a colour brochure.

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810

BSR:117R2

Model 970A is protected to 1000V peak. Input voltage protection with the probe, measuring resistance, is fuse protected up to 250V RMS for up to 10 seconds and will not damage the instrument. Should the resistor fuse become damaged from greater overloads, it can be easily replaced in its clips without soldering.

The Model 970A comes complete with three different sized tips. These tips include: a short tip which may be used for most applicatons, a longer tip for reaching difficult circuit test points, and a concave tip which may be mechanically cupped over wire-wrapped terminals and test pins. The probe tip has three working positions as well as a folded storage position. A standard banana plug with a clip lead can be plugged into the probe tip socket for measurements requiring two clip leads.

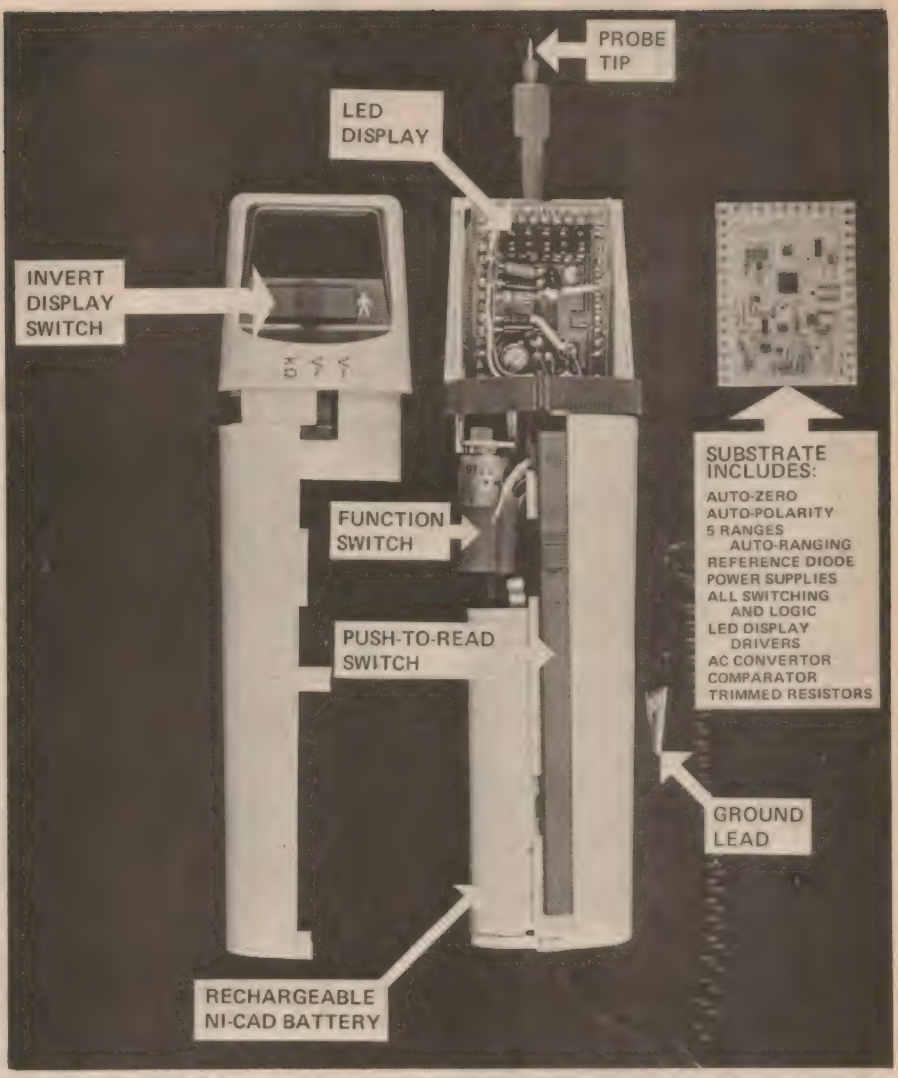
Nickel-cadmium rechargeable batteries and a battery charger are included with the Model 970A. Battery life permits more than 2,000 measurements to be made using the "press-to-read" switch, or at least 2½ hours of continuous operation with a full charge. Batteries can be recharged in about 14 hours.

Included with the Model 970A is the battery charger, one battery pack, a belt-clip carrying case, sun hood, three probe tips, and an operating manual housed in a hard, compartmented case. The probe case is made of high-impact plastic with built-in stress reliefs should the probe be accidently dropped from a workbench. The probe is 6½ inches long by 1⅝ inches wide. The instrument weighs 7 ounces (200 grams).

An optional ($36.00) current shunt / bench cradle which converts the 970A into a five-function bench instrument will become available in late 1973. A six-postion manual switch selects 5 ranges of AC and DC current from 0.0001A full scale to 1A full scale. A straight-through position is used for measuring AC and DC volts and ohms.

The Hewlett-Packard Model 970A Probe is priced at $220. An extra rechargeable Battery Pack, HP 97001A, is $20. Deliveries will begin from about the middle of this month.

For further information, contact the Hewlett-Packard office in your State. Adelaide (44 8151), Brisbane (29 1544), Canberra (49 8194), Melbourne (20 1371), Perth (25 6800) and Sydney (449 6566). Or write to Hewlett-Packard Australia Pty Ltd, Marcom Department, 22-26 Weir St, Glen Iris, Victoria, 3146. Offices also in Auckland (56 9651) and Wellington (5 9559), New Zealand.




*The top photograph at right shows a cutaway view of the new Hewlett-Packard Model 970A digital multimeter. At right, a technician uses the new multimeter in the inverted position to check out an item of equipment.*

# "Wind" For Electronic Organs

**This article describes the additon of wind noise and modern controls to the once popular Stromberg Carlson or Stromberg Playmaster organs. The cirucits could provide a basis for experiment with a variety of other older valve type organs.**

by C. D. TURNER*

The idea of adding "chiff" or wind noise to an electronic organ developed from a suggestion read in Allen Organ literature over a decade ago. It was further stimulated when it was desired to add 16' tones to a recently procured Stromberg-Carlson Organ. (The Playmaster version was described in "Electronics Australia" December 1961 to June 1962. The 16ft addition followed in Feb 1969).

When an organ pipe is blown, the sound produced contains not only the fundamental and overtones generated in the pipe resonator but also a proportion of noise resulting from air escaping at the flue of the pipe. This is determined by factors such as wind pressure and voicing nicks and varies from rank to rank.

Ideally each "pipe" of an electronic instrument would be simulated individually. To do so would require a great deal of complexity, particularly on an existing instrument. The alternative adopted was to mix a suitably voiced hiss with the desired tones so that a suitable relationship was maintained to the number of speaking notes.

Noise was generated in the now well established circuit using a reverse biased emitter-base junction. (An AT337 is shown only because the required junction was still intact).

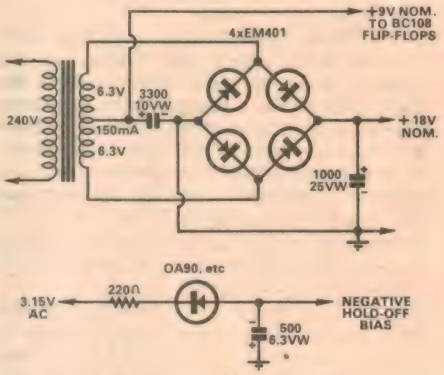
Output from the noise "diode" needs to be amplified. The requirements are that the amplifier must be in a quiescent cut-off condition, must be gated into amplification when a note is played and ideally increase noise level as further notes are added to the chord. It was considered that the instrument itself provided a means of achieving this.

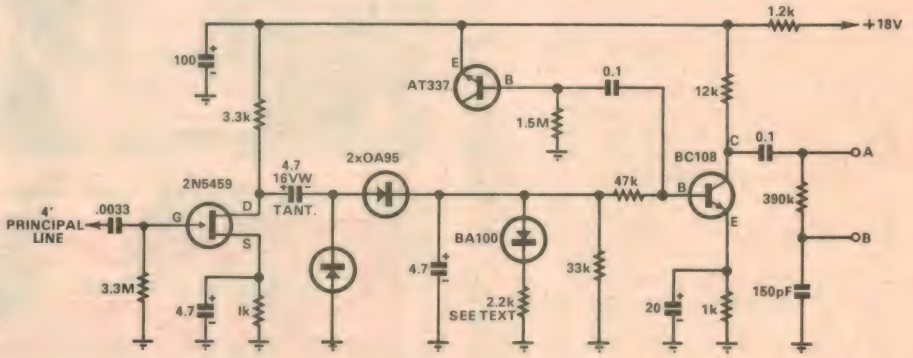
A signal was taken from the 4ft complex tone at the 12AU7 anode. In anticipation, this had been given the additional gain of a fully by-passed cathode and the mixing resistor doubled in value. This signal is amplified by a 2N5459. A FET was chosen since its high input impedance does not severely shunt the valve amplifier, its gain is moderate and its output impedance is sufficiently low quickly to charge the rectifier filter capacitor.

The rectifier is a half-wave doubler which charges a 4.7 uF capacitor. A 33k resistor shunts this capacitor to ensure that it can fully discharge after a brief time and forms part of the circuit ensuring that the noise amplifier cuts off positively.

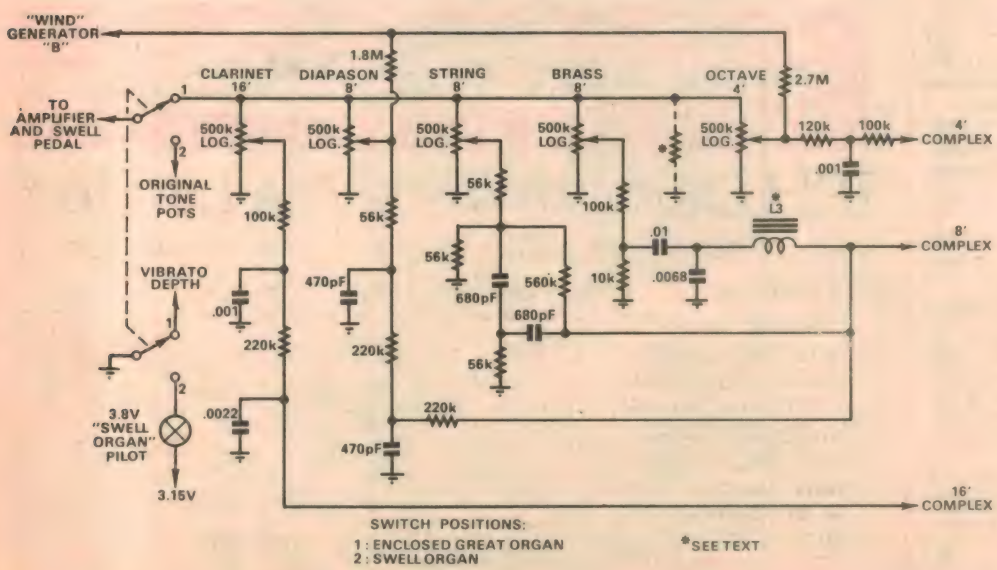
Application of the voltage developed through a series resistor of 47k provides a forward bias to the BC108 causing it to conduct. While 0.6 volts must be applied to the base before it begins to conduct it is apparent that the amplifier can easily be pushed into saturation. A silicon diode and resistor as shown controlled this effect. The 2.2k resistor provided about the right dynamic range but may require adjustment in individual cases.

A simple filter, 390k and 150pF, "voices" the wind which is applied from B to the 8ft Diapason annd 4ft Principal controls through resistors of 2 to 3 megohms. Obviously both quality and quantity of wind must be tailored to suit individual preferences as well as amplifier and loud-



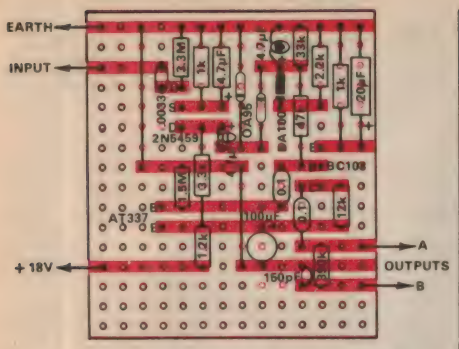

*Circuit details of the wind noise generator for the Stromberg Carlson electronic organ. The noise is intended to appear as a subtle background to certain voices, being not quite the same thing as "chiff".*




*Left: The original Stromberg Playmaster electronic organ provided a fixed stop combination selectable by a switch. With the current availability of slider type potentiometers, it is now a relatively simple matter to provide a second set of adjustable voices, greatly enhancing the versatility of the single manual instrument.*

*Shown at the top is the simple power supply devised to supply the wind noise generator (+18V) and the modified 16ft dividers requiring +9V and a negative hold-off bias. The power supply was supported beneath the tone generator in the original organ.*

* Rev. C. D. Turner Th.L., 53 Elizabeth St, Riverstone, NSW 2765.




*The wind noise generator can be laid out very simply on Veroboard, perhaps the same piece that already holds the 16ft dividers.*

speaker characteristics.

The circuit was laid out on the 16ft divider board on the original instrument and occupied the space of about two dividers. It draws less than 4mA at the 18V specified.

Apart from direct application to the Stromberg-Carlson and similar organs the basic idea should be applicable to a wide variety of instruments where each footage is commoned prior to the formant filters. It was verified that the circuit could be adapted to operate from the 8ft common line and the wind fed to 8ft stops.

There is some feed-through of the gating signal. Presumably the ripple on the 4.7 uF capacitor appears at the base and is amplified. The level was not high or disadvantageous and, after verifying that it could be virtually eliminated by splitting the 47k resistor and by-passing, it was left as is!

The Stromberg-Playmaster incorporated a composite "Full Organ" filter. Since there is space at the left hand end of the key jamb it was thought that greater versatility could be provided by making it adjustable, using modern slide potentiometers. Six can be accommodated and these were mounted on a panel which was fitted into the cabinet beyond the lowest key. Many organs either have or make provision for controls there.

The chosen format provided for (left to right); Pedal Volume, spaced slightly wider than the rest, 16ft Clarinet (c1-f3); 8ft Diapason, 8ft String, 8ft Brass and 4ft Octave. The original pedal volume was utilised for a 16ft Wald Flute.

A set of filters was constructed on Veroboard. Apart from the Diapason the aim was to provide voices slightly different from those already provided. The junk box yielded a discarded loud speaker transformer with a serviceable primary which, after packing the gap to achieve a suitable effect, has done service in the "brass" filter. The values chosen produced a level several dB higher than the original but this could be reduced by a padder resistor shown dotted.

This system is far more convenient than the rotary pots, and is similar in concept to the Hammond drawbars and Yamaha tone levers. Application to other instruments with space available at either end of the keyboard can be made by studying the type of circuitry involved in the existing filters.

Alternatively, the very enterprising may even elect to abandon the preset switching and install such adjustable controls, using the filters already there, on one manual.

*Continued on Page 125*

# Sopic: a new audio-visual concept

Malcolm Goldfinch, Managing Director of Convoy International, saw this intriguing little device while touring Japan recently. A highly novel adaptation of the conventional disc playback system, it has been developed especially for education and training applications. We think you'll agree that it could have many other uses. . .

With a conventional record player, the disc goes on the player, right? And then the disc turns round, the pickup stays more or less still, and the sound comes out. That's what we thought, too, until we saw the Sopic record player.

With the Sopic unit, the basic requirements are still there: a disc with the recorded spiral groove, moving relative to a pickup stylus. But here the similarity with a normal record player ends. In this case it is the player that is placed on the disc, not the disc on the player; and the pickup that goes round and round, not the disc. The disc just lies back and enjoys it, so to speak!

This apparently upside-down and back-to-front arrangement is not just the result of extreme perversity in it's Oriental designers. It has been done for two very good reasons.

One is that since the discs are not required to move, they may be fixed permanently into books, brochures or magazines. The other reason is that with no pickup to handle, the Sopic player tends to be much more easily operated by children and blind folk. It is simply a matter of locating the player correctly on the disc, and pressing the button.

The system is ideally suited for educational and training applications, and for providing audio literature for the blind, and these are in fact the very uses for which the Sopic system was developed. The company which developed it, the Japan Metals and Chemicals Co Ltd, is not an electronics firm, but a large and long-established processor of raw materials. It produced the Sopic system as a public service, simply because it belived that there was an urgent need for a low-cost and easily operated audio playback system for education.

In passing, it is interesting to note that the Sopic designers have still opted for the conventional grooved gramophone disc, although magnetic recording is currently more fashionable. Presumable it would have been possible to develop a similar device with a spiralling head, to play magnetically recorded discs. The Sopic literature doesn't give their reason for the choice, but our guess is that it was the simple economic one that discs are still much easier to mass-produce at low cost.

The Sopic player is very compact, being housed in a cylindrical case 97mm in diameter and 115mm high. It weighs 640 grams without its four 1.5V penlight cells. The rotating pickup assembly at the bottom of the case is fitted with a ceramic cartridge, and is driven at a constant 45 rpm by a 6V governor-type DC motor. The audio amplifier is a single IC capable of delivering about 350 milliwatts to the 77mm round loudspeaker.

The player is designed to play discs 82mm in diameter, which can play for about 4½

*The accompanying photographs illustrate the interest shown by Anne (6) and Grant (4) in the Sopic audio-visual system. Their interest clearly demonstrates the educational potential of Sopic.*

minutes when high-density variable pitch recording is used. Typically the discs are stamped from thin transparent plastic, and are glued to the pages of a book or brochure.

Convoy International loaned us the Sopic player pictured, together with a language-teaching book containing Sopic discs. Almost all of the EA staff members were intrigured by the system, and were stimulated to dream up all sorts of interesting uses for it. One thing we all agreed on was that it should be very suitable for those with limited or no eyesight, whether children or adults, because it is so easy to use.

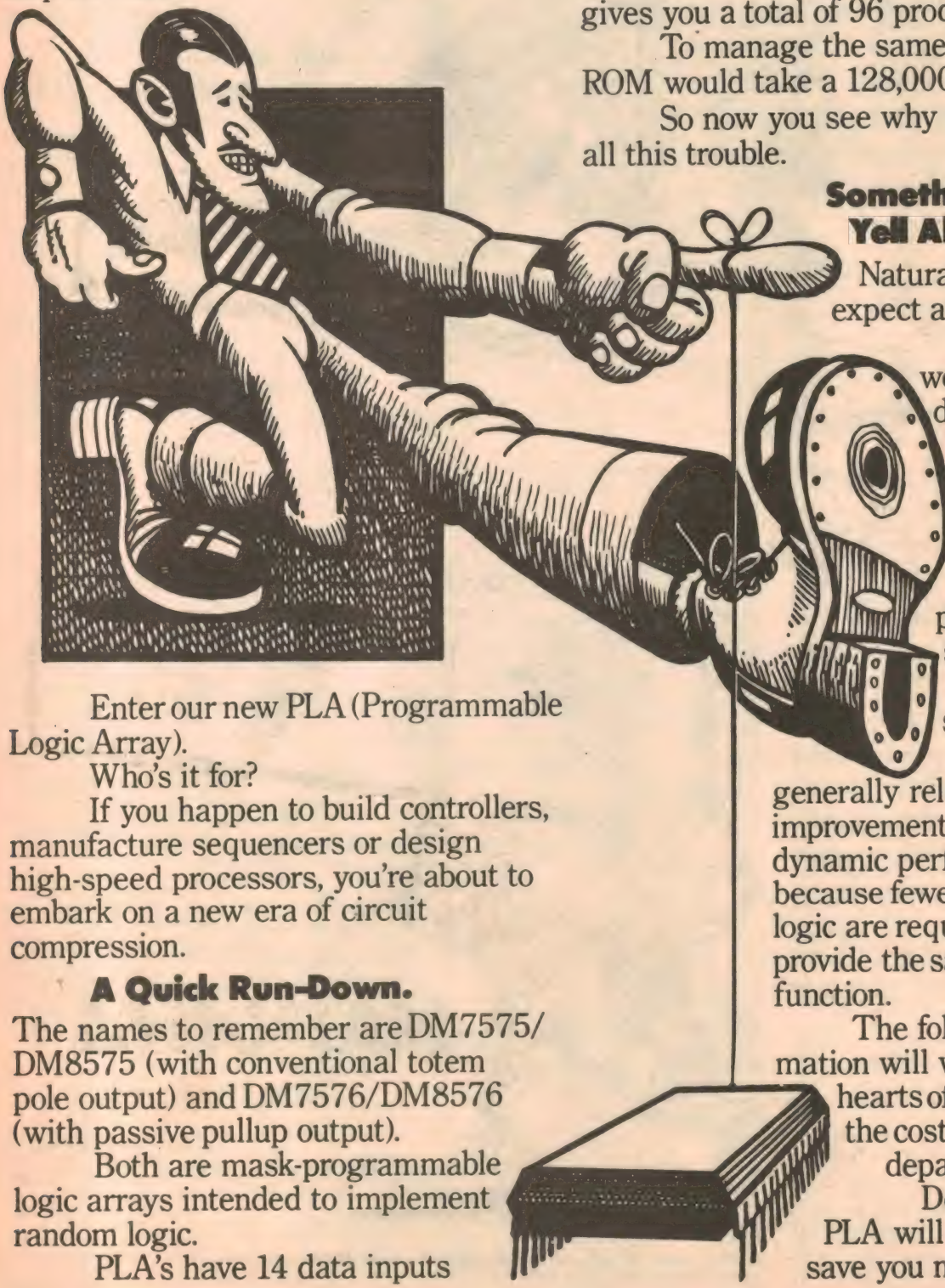
But it was when we introduced the system to some small children that its potential as an educational medium really started to become evident. When Editor Jim Rowe took it home and showed to it his daughter Anne, 6, and son Grant, 4, they took to it like a proverbial duck to water. Anne had no trouble at all in operating the player, and became fascinated with the elementary Japanese lessons in the book. Naturally these made less impression on Grant than the mechanics of the Sopic player, but had there been discs of nursery rhymes or stories he would have been equally intrigued.

Clearly the Sopic system is very suitable for educational use, and should find a lot of use in language and social studies teaching. It would easily form the basis for "language laboratories" costing considerably less than present facilities using tape cassettes, yet with virtually all of the important features.

Education authorities, institutions and private individuals interested in the Sopic system should contact Convoy International Pty Ltd at the corner of Plunkett and Maclean Streets, Woolloomooloo, NSW 2011. The telephone number is 358 2088.

# NATIONAL'S

Just when the world had decided that working with ROM's was hot stuff, National moved the state of the art one step forward.



Enter our new PLA (Programmable Logic Array).

Who's it for?

If you happen to build controllers, manufacture sequencers or design high-speed processors, you're about to embark on a new era of circuit compression.

**A Quick Run-Down.**

The names to remember are DM7575/DM8575 (with conventional totem pole output) and DM7576/DM8576 (with passive pullup output).

Both are mask-programmable logic arrays intended to implement random logic.

PLA's have 14 data inputs and 8 outputs. Each output provides an equation where each product term can contain any combination of 14 variables or their complements. That gives you a total of 96 product terms.

To manage the same thing in ROM would take a 128,000 bit memory.

So now you see why we went to all this trouble.

**Something To Yell About.**

Naturally, you'd expect advantages.

And you won't be disappointed.

To begin with, the new design will yield a higher performance solution like 90 nanoseconds.

This generally relates to an improvement in system dynamic performance because fewer levels of logic are required to provide the same control function.

The following information will warm the hearts of everybody in the cost accounting department.

Designing with PLA will definitely save you money. This is

# NEW PLA-THING.

due to the more efficient use of memory array as compared with the conventional rectangular array ROM.

You'll also reduce the system manufacturing cost because you reduce component assembly cost, printed circuit board cost and probably even connector costs within the system.

Besides that, the PLA is keen to work with.

**Be The First On Your Block To Own One.**

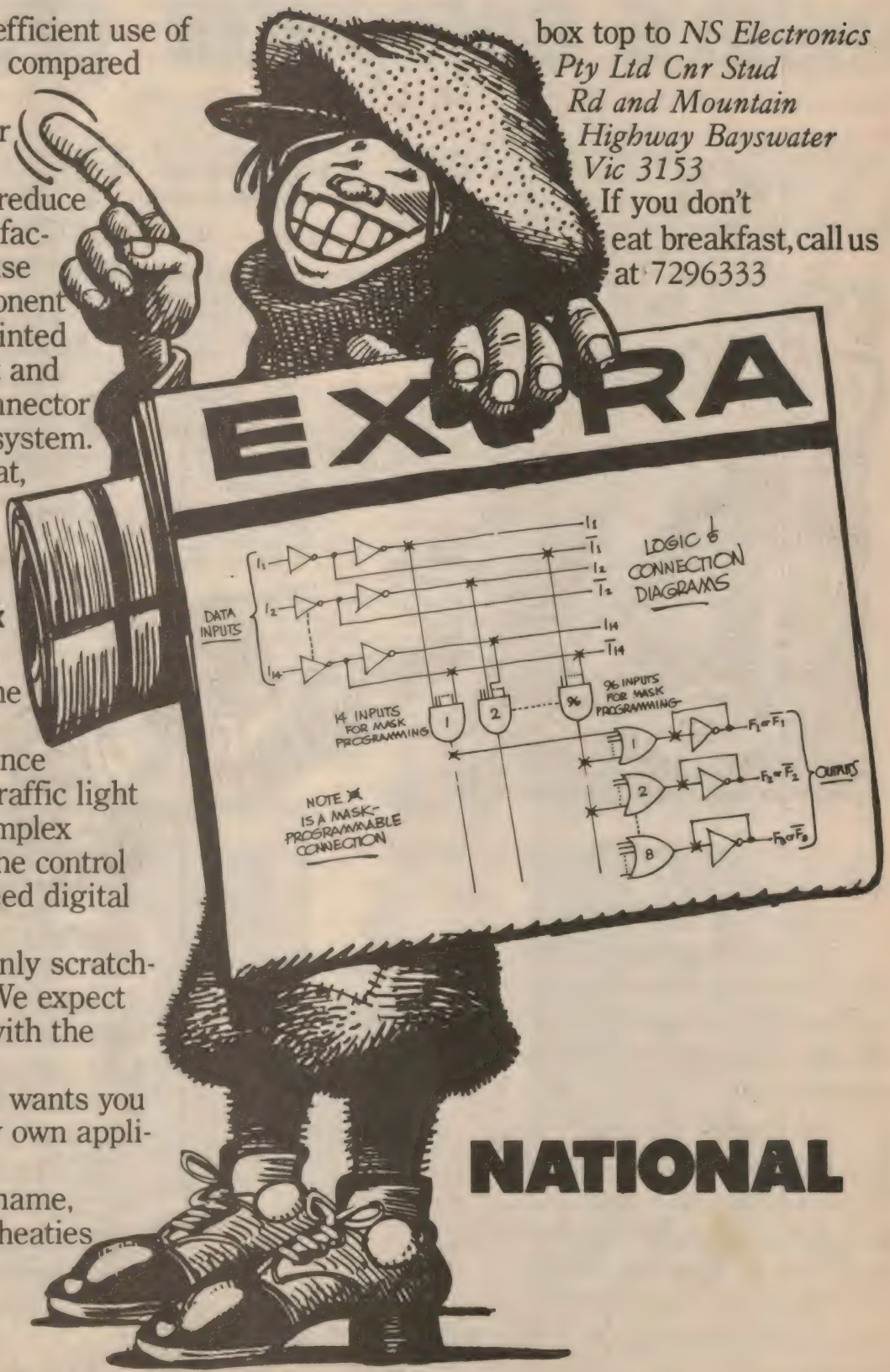
Applications of the PLA range from fairly slow appliance sequencers and traffic light controllers for complex intersections to the control logic for high-speed digital processors.

But that's only scratching the surface. We expect you to come up with the far-out stuff.

So National wants you to have your very own application notes.

Send your name, address and a Wheaties box top to *NS Electronics Pty Ltd Cnr Stud Rd and Mountain Highway Bayswater Vic 3153*

If you don't eat breakfast, call us at 7296333

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# Government controls India's computer growth

**According to our correspondent, N. Viswanath, the introduction of computerisation and automation into India is not without its difficulties. In this report he lists some of the current problems and discusses the efforts made to find solutions.**

A recent study sponsored by the United Nations Industrial Development Organisation and undertaken by the National Institute for Training in Industrial Engineering (NITIE) has been made on the effects of computerisation in India. India was selected for the study because it reflects most of the problems of developing countries.

India's first computer, installed in the mid-fifties at the Indian Statistical Institute in Calcutta, was used for scientific and research purposes. The first computer for commercial applications was installed by an American oil company. Since then, the number of computer installations has increased steadily and by June 1972, 170 installations were in operation throughout the country — 46 in Bombay, 23 in Delhi, 18 in Calcutta, 15 in Bangalore and the rest in other places. Of these business and industry use 80, government 14, educational institutions 20, research establishments 21, and public utilities 33.

Most computer installations in India are second generation systems as manufacturing facilities available until recently were restricted to this type. Progress has been made, however, in the manufacture of third generation computers. A small, high speed digital computer intended for real time applications, and suitable for commercial production, has recently been developed at the Bhabha Atomic Research Centre in Bombay.

Designated the TDC 12, this computer is manufactured by the Electronics Corporation of India which is India's only computer manufacturer. By the end of March, 1973, 18 TDC 12 systems had been installed and put into operation. A new model designated the TDC 312 has recently been developed. This model is architecturally the same as the TDC 12, but uses integrated circuits instead of discrete components.

A larger machine with a longer wordlength, the TDC 16, is under development using third generation technology. Work is also in progress on a medium size computer with a 32-bit word length and a one microsecond cycle time. Third and fourth generation technology is being used in the development of this computer which is intended for time sharing, multiprogramming and large scientific and business applications.

The NITIE study has advocated the Government's encouragement to technological institutions for research into computer hardware, peripherals, and software, and recommends that it allow foreign collaboration for the production of fourth generation computers. Other recommendations include government incentives for the export of software, the provision of telecommunication facilities for remote data transmission, and financial assistance from the government to management training institutions for research into problems affecting computerisation.

The setting up of public corporations exclusively for the manufacture of computer systems, and the creation of a computer — based management information system within the Bureau of Public Enterprises has also been suggested.

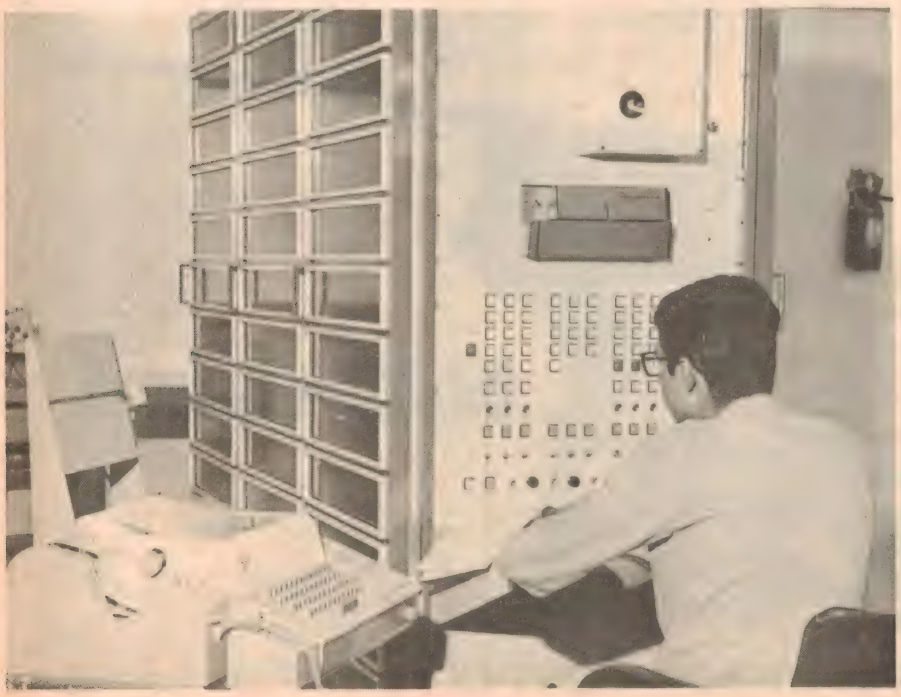
No evidence could be found that computers had led to retrenchment in any business organisation in India.

Automation is, however, a controversial economic problem in India. It has created a difficult political situation for the government which is caught between the interests of commercial and industrial concerns on one side, and trade unions on the other. Hostility towards automation has recently been expressed by union movements who argue that it can affect employment potential if used as a labour saving device.

Realising the seriousness of the situation, the Indian Government set up a committee on automation under the chairmanship of Prof. V. M. Dandekar of Bombay. The committee's report has recommended that commercial and industrial developments should use computers only after agreement with their respective labour unions.

Other main recommendations of the report are: proposals for computer installations should be individually examined by two experts, jointly selected by management and unions from a panel maintained by the government; computers should not be under-utilised; and the needs of computer users should be met from computer centre facilities to be created.

India's problem is to utilise her huge labour resources, and limited other resources, to her maximum advantage within the shortest possible time. This is a national problem which can be aggravated by automation and computerisation. Whilst automation and computerisation may be superior techniques, they are not generally suited to Indian conditions. What is required is an adaptation of capital intensive techniques to suit the labour intensive situation in India.



*India's own computer, the TDC 12, designed and developed by the Bhabha Atomic Research Centre and manufactured by the Electronic Corporation of India Ltd.*

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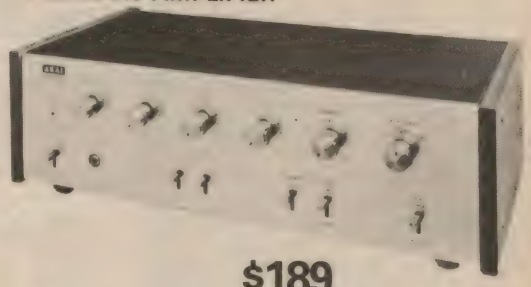

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# Build our Digi-Meter: a DVM without tears

**Were you intrigued by the digital voltmeter project in our January and February issues, but didn't tackle it because it seemed a bit complex? Here's a basic DVM which almost anyone should be able to put together with complete success. Despite this its performance is very impressive.**

**by JAMIESON ROWE**

Not very long ago, before integrated circuits came along, digital voltmeters or "DVMs" were large and costly instruments. Because of their cost and complexity they tended to be found only in the rarified atmosphere of the research laboratory. The idea that a DVM would ever be used for everyday measuring jobs seemed a futuristic pipe-dream; as for building a DVM into a piece of equipment as a direct replacement for a moving coil meter movement, that was virtually unthinkable!

Yet, thanks to modern semiconductor technology, and the increasingly complex ICs which it has produced at ever-lower costs, both these dreams have now become a reality. Low cost multi-range DVMs are now available for little more than the cost of a good analog multimeter, and are already being used even in servicing and hobbyist situations. Not only this but more and more original equipment manufacturers ("OEMs") are fitting single-range DVM "panel meters" into equipment in places where once they would have used moving coil movements.

The latest generation of these digital panel meters are truly impressive little devices, a tribute to modern semiconductor devices and advanced circuit design. A particularly outstanding example is the Model AD2010/E recently released by Analog Devices, Inc., of Norwood, Massachussetts, available in Australia from Parameters Pty Ltd.

The size of the AD2010/E is a compact 45 x 76 x 20mm, less than many moving coil movements. It weighs only 113 grams (4 ounces). Yet crammed into this compact package is a complete 3½-digit DVM with a full-scale sensitivity of 199.9mV and an accuracy of .05pc plus/minus 1 digit in the least significant position. It also offers such features as bright seven-segment LED readouts with 7mm-high digits, display storage, automatic polarity selection, automatic zero correction, internal overload protection, blanking of leading zeros, BCD outputs for data logging, a DC input resistance of 100 megohms, a normal-mode 50Hz hum rejection of 40dB, and a common-mode rejection of 60dB.

In short, it is a true state-of-the-art single range DVM, compressed into a little black box half the size of many conventional meter movements. And the price is an attractive $89.00, which compares very favourably with the cost of multi-range instruments of a similar standard of performance.

As soon as we saw the AD2010/E advertised a few weeks ago, we wondered whether it might be possible to use it as the heart of a basic and easy to build multi-range DVM for the home constructor. When we approached Parameters with the idea, they were confident that it could be done. And so, with their help and co-operation, the Digi-Meter was born.

As you can see from the photographs and the circuit, it is essentially little more than the AD2010/E fitted into a case, with a power supply and a simple input attenuator circuit to provide four higher voltage ranges. All the real credit must go to Analog Devices! To make the instrument just that more attractive, however, we have added a simple constant-current source circuit, to provide four additional resistance ranges.

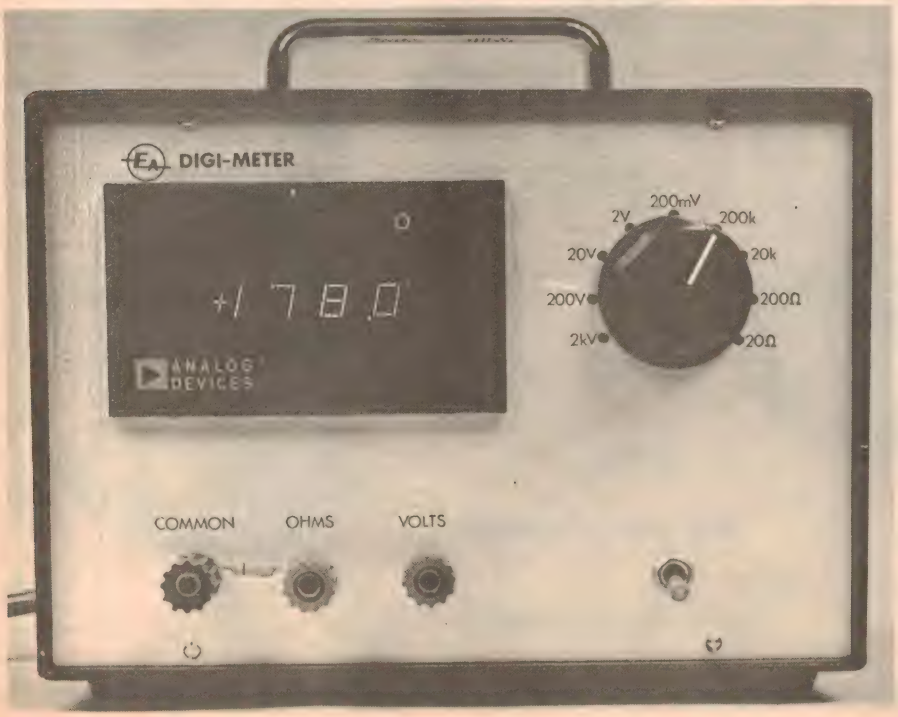
The circuit itself must surely be about as simple and as straightforward as one could get with a practical multi-range meter.

To supply the 5V DC at about 600 mA required by the AD2010/E, there is a full-wave rectifier circuit using two 50V/1A silicon diodes and a 15V centre-tapped transformer, followed by a 3-terminal 5V IC regulator. The regulator we have used in the National Semiconductor LM309K, which comes in a TO-3 metal package, but an alternative would be the Fairchild uA7805 in either its plastic or TO-3 package.

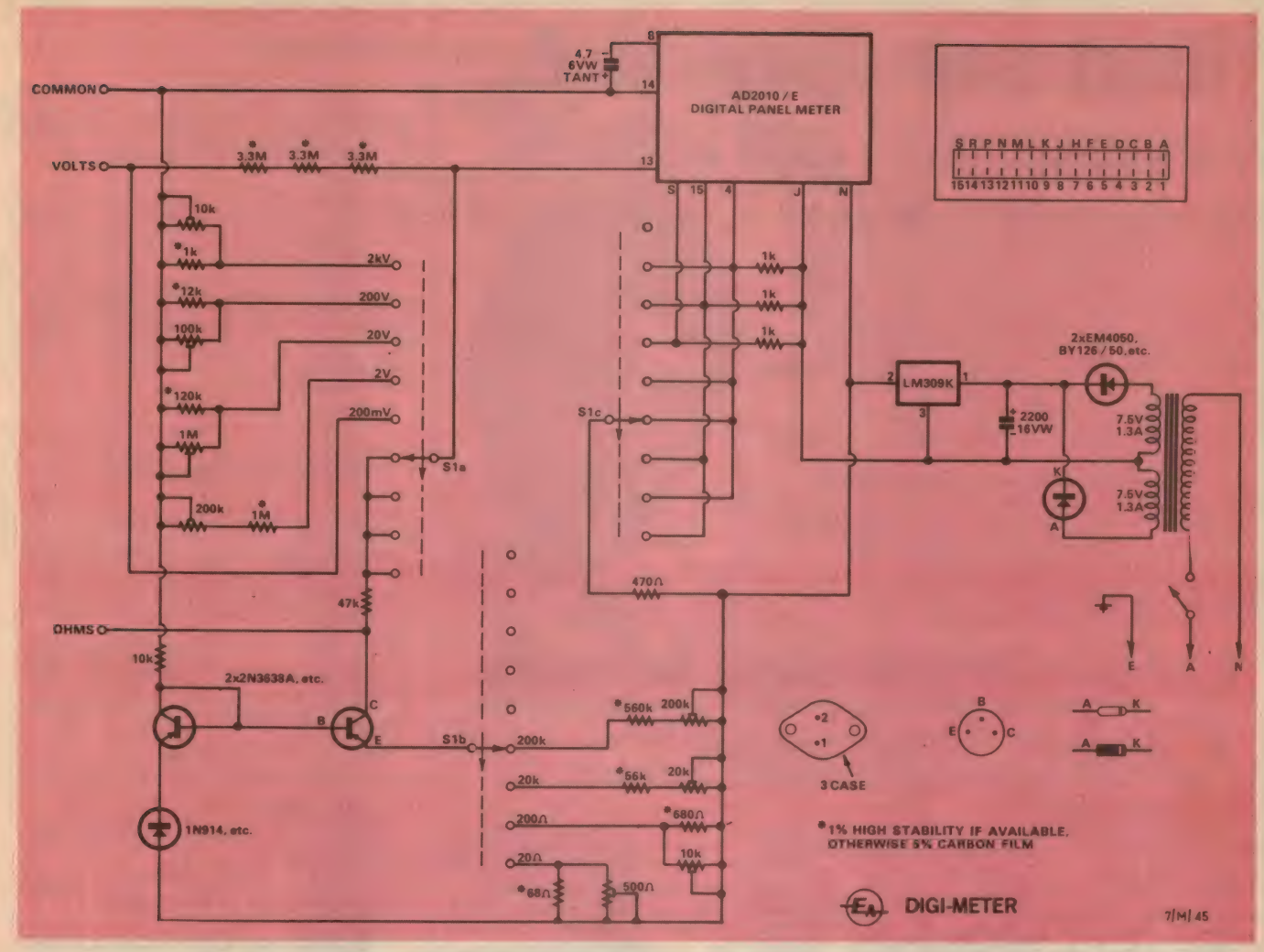
As mentioned earlier, the basic DC input resistance of the AD2010/E is 100 megohms, and its sensitivity 199.9mV. To provide the higher voltage ranges we have used an input voltage divider system similar to that in the more complex DVM. Three series-connected 3.3M resistors are switched into circuit in series with the AD2010/E input, with different shunt resistors switched directly across the input for each range.

It would not be sufficient simply to use standard close tolerance fixed resistors for the range divider shunt resistors, because the closest tolerance normally available is 1pc; this would quite seriously degrade the basic .05pc accuracy of the AD2010/E. Hence it is necessary to use preset adjustable pots for each range, to allow more accurate calibration. It is still desirable to use high stability resistors, if they are available, but more in the interests of stability than for close tolerance.

The advantage of the particular input attenuator system we have used is that each of the high voltage ranges may be calibrated independently; there is no adjustment interaction (apart from the in-




*Built around a modern digital panel meter, our Digi-Meter combines high performance with simplicity of construction. Readout is via bright LED displays.*




*The circuit is simplicity itself, thanks to the Analog Devices digital panel meter. Only a handful of other components are required for the power supply and regulator, input attenuator and current source circuit.*

ternal calibration of the AD2010/E, which may be regarded as a reference). The fixed 9.9M resistance in series with the input on all the higher voltage ranges also gives additional overload protection. Note that the input resistance on the higher voltage ranges varies between about 10 and 11 megohms, which is quite suitable for most measurements.

The constant current source used for the resistance range is a simplified version of that used in the more elaborate DVM, and is also designed to operate from the same 5V DC supply used for the AD2010/E. It uses a single forward-biased 1N914 or similar silicon diode as the basic voltage reference, with a second diode-connected transistor to balance the Vbe drop of the actual current source device. Both transistors are high-gain PNP silicon devices such as the 2N3638A. Preset resistors are used again in the emitter feedback circuit, to allow accurate calibration of the four ranges. The currents for the four ranges are 1uA, 10uA, 1mA and 10mA.

Provision of the decimal point selection circuit proved to be a little tricky, because the AD2010/E is designed so that all decimal point LEDs are normally "on". For its normal application as a single-range panel meter, this is no problem as the unwanted points are simply blanked by shorting the appropriate pins to the negative rail. But in the Digi-Meter we had basically only one single-pole 9-position switch section available for decimal point selection — hardly the most appropriate for the job.

After a little head-scratching we came up with the system shown on the circuit, and it seems to work quite well. Essentially we have taken each of the AD2010/E decimal point pins permanently to the negative rail via 1k resistors, and then used the switch to re-apply 5V DC to the pin of the decimal point needed for each range, via a 470-ohm protective resistor. The 1k resistors appear to be quite low enough to reliably blank the undesired LEDs, while at the same time being large enough to allow any one to be unblanked when desired.

As you can see from the photographs, our prototype Digi-Meter was built up in one of the Australian Transistor Company's nominal 7 x 5 x 4 inch vinyl-covered metal instrument cases. This produces a neat and professional little unit, yet involves a minimum of work. We mounted the AD2010/E directly on the front panel (it clips into a plain rectangular hole 80 x 45 mm), along with the range switch, the input terminals and a small mains on-off switch.

Most of the rest of the wiring is mounted on the rear panel, which like the front panel is also removable. We have used one of Ferguson Transformers' low profile transformers, the PF 3597, which takes up little space and provides adequate clearance behind the AD2010/E. Above the transformer on the panel is a length of miniature resistor panel some 18-lug pairs long, which supports the basic power supply rectifier components, the constant-current source for the resistance ranges, and all the preset calibration pots. The latter are adjustable when the case is assembled, through a row of small holes in the top of the case.

The mains cord enters the case at the lower far end of the rear panel, its entry being made via the usual grometted hole. It is clamped in the approved manner with a P-clamp, and the active and neutral wires terminated in a section of "B-B" connector strip. The earth wire is soldered to a lug screwed firmly to the metal panel, so that even when the panel and transformer are removed from the rest of the case, both remain earthed.

The only component not actually mounted on either the front or rear panels of the case is the IC voltage regulator, which is mounted on a simple heatsink bracket bent up from a scrap of 16G aluminium sheet. The bracket measures 65 x 60 x 10mm, and is mounted in the bottom of the case by two of the screws used to attach the rubber feet.

If the usual four mounting holes for a TO-3 device are drilled in the heatsink, this will suit either the LM309K device or the TO-3

## DIGI-METER

to measure a voltage in a low resistance circuit, (say less than about 10k), the effect will be very small, and can generally be neglected.

For measurements in higher resistance circuits, the only way of correcting for the error produced is to first make the measurement, then simulate the resistance of the circuit by connecting a resistor of similar value across the Digi-Meter input terminals. The residual reading produced is then subtracted from the original reading, algebraically as before, to obtain the corrected reading.

## THE PARTS NEEDED

*1 Case, ATC type 754 or similar.*
*1 Digital panel meter, Analog Devices type AD2010 / E.**
*1 Power transformer, 15V CT at 1.3A, low profile (Ferguson type PF3597 or similar).*
*1 Miniature rotary switch, 2-sections each 2-poles 9 positions (MSP type 69003 / 131).*
*1 Miniature toggle switch, SPST 240V rating.*
*1 Instrument knob, large.*
*3 Screw terminals, 2 red & 1 black.*

*SEMICONDUCTORS*
*2 BY126 / 50, EM4050 or similar 50V silicon diodes.*
*1 1N914 or similar silicon diode.*
*2 2N3638A or similar silicon PNP transistors.*
*1 LM309K, uA7805 or similar 5V-1A regulator.*

*RESISTORS*
*Half watt, 5pc: 470 ohms, 3 x ik, 10k, 47k.*
*High stability for preference: 68ohms, 680ohms, 1k, 12k, 56k, 120k, 560k, 1M, 3 x 3.3M.*
*Miniature preset pots: 500ohms, 2 x 10k, 20k, 100k, 2 x 200k, 1M (all linear).*

*CAPACITORS*
*1 4.7uF 6VW tantalum.*
*1 2,200uF 16VW electrolytic.*

*MISCELLANEOUS*
*Mains cord and plug, handle and rubber feet for case, 30-pin connector for AD2010 / E, 18-lug pairs section of miniature resistor strip, 3-bay section of "B-B" connector strip, P-clamp for mains cord, scrap of 16G aluminium for regulator heatsink, connecting wire, solder, etc.*

*Note: resistor wattage ratings and capacitor voltage ratings are those used for the prototype. Components with higher ratings may generally be used, providing they are physically compatible. Components with lower ratings may also be used in some cases, providing the ratings are not exceeded.*

**Available from Parameters Pty Ltd, 68 Alexander Street, Crows Nest NSW 2065.*

completed and power is to be applied for the first time, it would be a wise precaution to temporarily detach the 30-pin connector from the AD2010 / E until you make sure that the power supply is correctly delivering the nominal 5V. This will prevent any possible damage should a wiring error have been made.

When you have satisfied yourself that the voltage socket between pins J and N on the socket is between the acceptable limits of 4.8V and 5.2V, turn off the power temporarily and refit the 30-pin connector to the AD2010 / E. Reapplying the power should then result in normal operation, with digits visible on the readout display.

The only remaining operation is that of calibration. This is a little easier than with the more complex DVM, at least in one respect: the 200mV range is already calibrated. If the full accuracy of the AD2010 / E is to be retained for the other ranges, however, it will be necessary to perform a full-scale calibration using a reference instrument and a stable source of adjustable DC.

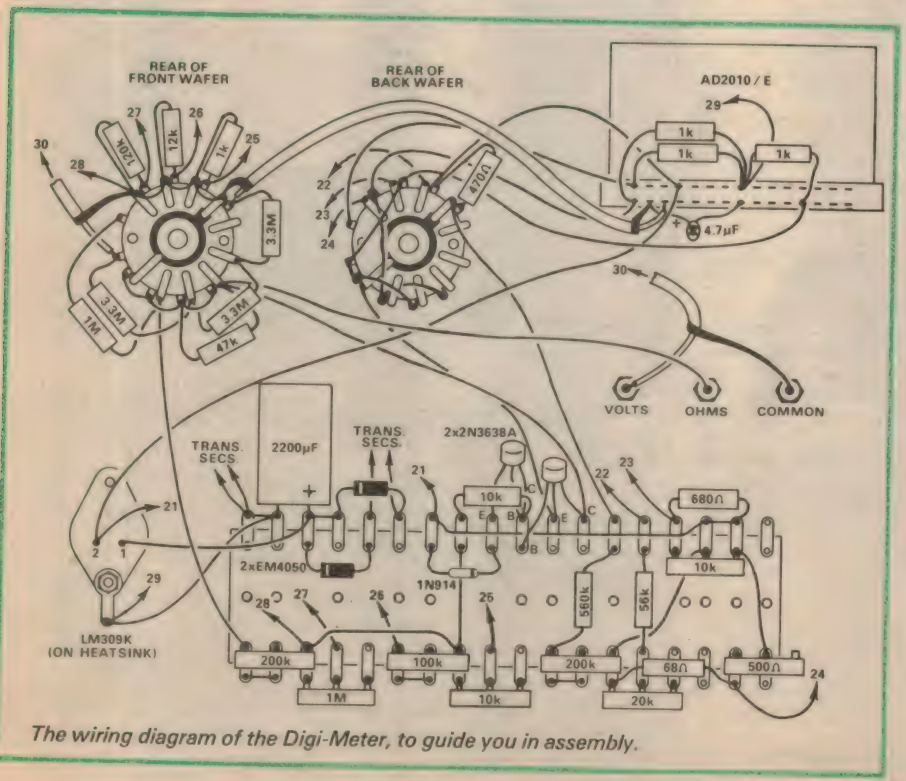
Probably few readers will be in a position to do this, so that in many cases it will be necessary to do the next best thing: calibrate the 2V and 20V ranges using a source of reasonably known voltage, and then use a few suitable voltages present in an amplifier or other piece of equipment to bring the 200V and 2kV ranges into as close agreement as possible with the lower ranges.

The most convenient source of a reasonably known voltage for most readers will probably be a new mercury cell of the type used in cameras having inbuilt cadmium sulphide exposure meters. A suitable cell is the Eveready type EPX-13, which should be available at all photographic stores and major pharmacies.

When new, these cells have an open-circuit terminal voltage of 1.3566V, which drops to around 1.3524V after 12 months at an average temperature of about 21 degrees C. It is therefore reasonable to assume that virtually any such cell will have an unloaded voltage of very close to 1.35V, providing it is in reasonably good condition.

Even better, a cell bought as new from a large city photographic store, where it is likely to be fairly fresh, could be reasonably assumed to have an unloaded terminal voltage of 1.355V. Such a cell could therefore be used to calibrate the 2V and 20V ranges to better than 1 per cent.

*The inside of the Digi-Meter, showing how the parts are arranged. The preset calibrating pots are adjusted through holes in the top of the case.*




*The wiring diagram of the Digi-Meter, to guide you in assembly.*

Calibration of the resistance ranges is best done using a precision decade resistance box, if access to such a device is possible. Some readers may be fortunate enough to gain access to such a decade box at their local technical college. For those unable to do this, probably the only practicaly alternative is to obtain a few representative close-tolerance resistors, and use these as references.

A final note: when you use the Digi-Meter, you may notice that there will be a very small but non-zero residual reading on the 2V range for open-circuit input. Similarly there will be a more significant residual reading on the 200mV range under the same conditions. Both are normal, and are due to the small bias current drawn by the input circuit of the AD2010 / E.

On the 2V range the residual reading should bo so small that for most measurements it may be ignored. However for readings where the maximum possible accuracy is desired, it is only necessary to subtract the residual reading algebraically from the reading produced for the voltage being measured, to obtain the best estimate of the true voltage.

With the 200mV range the situation is not quite so simple, because the effect of the bias current will depend upon the resistance of the circuit in which the measurement is being made. If the Digi-Meter is being used

*Continued on Page 125*

# *Test Components and Appliances with an*

# Insulation Checker

by LEO SIMPSON

Have you checked the insulation of your electrical applicances lately? At high voltage? This handy checker lets you do this sort of test easily. It also checks transformer and cable insulation, capacitors and high value resistors.

There are many occasions when an insulation tester is useful in the laboratory or home workshop. For example, whenever an electrical appliance is repaired, an important check is to test the power cord. There should be a low resistance connection of the earth lead to the applicance case, and also adequate insulation resistance between the active and neutral conductors and the case.

Often these tests are performed with a multimeter switched to an appropriate "Ohms" range; the low range for earth connection and the highest for the insulation resistance. The insulation resistance should be as high as possible, ie, many megohms.

While the multimeter check is better than none, the insulation of the appliance should really be tested at a high voltage — many insulation breakdowns will not show up at the low applied voltage from a multimeter. The usual test voltage for electrical appliances is 500 volts DC.

The time-honoured method of checking the insulation resistance of electrical wiring and appliances is to use a "megger" tester, which incorporates a hand-driven generator that produces a nominal 500V DC across the load. The insulation resistance measurement is then read on the megger's dynamometer movement (an RMS indicating meter with fixed and moving coils) which takes into account the applied voltage and the current flowing. This is the method used on factory assembly lines and by electricians.

Unfortunately, most home repairmen and hobbyists do not have access to the hand-driven type of insulation tester. Indeed, many electricians now use more compact, battery-driven insulation testers similar to the one presented here. The 500V Insulation Checker described here satisfies the requirements of the home repairman and hobbyist. It is compact, economical to build and quickly shows up insulation defects.

Besides the applicance testing mentioned above, the Insulation Checker is handy for checking the insulation of older transformers and filter chokes. These should have high resistance between windings and also between windings and core. It can also check for insulation breakdowns in automotive generators and starter motors. Besides these, it can give a rough-and-ready check on the insulation resistance of paper and plastic dielectric capacitors, and also the value of resistors of more than 1 megohm which are not easily checked with a multimeter.

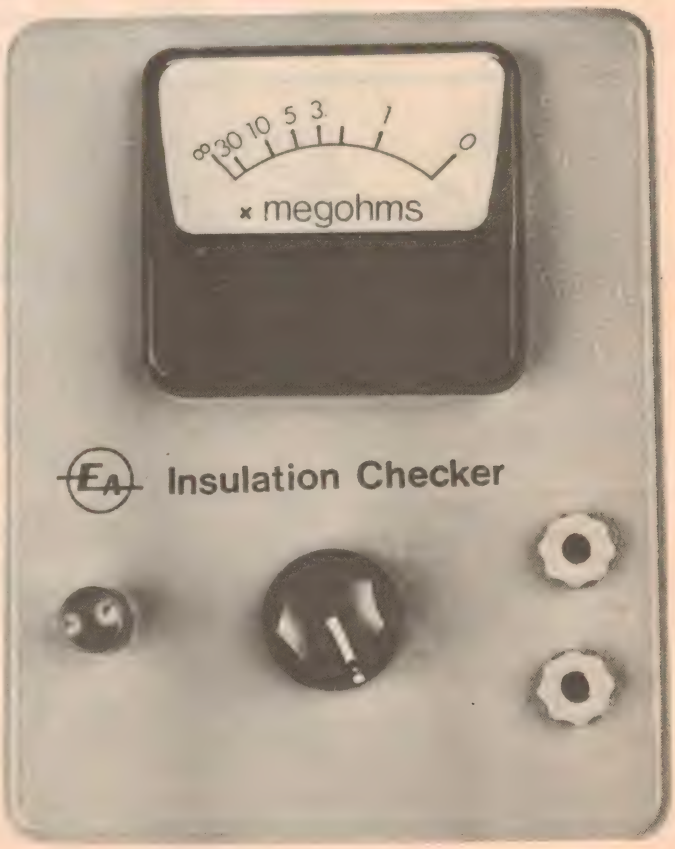
As the circuit diagram shows, the high voltage is generated by a two-transistor converter. The two transistors operate as a transformer coupled multivibrator. The transistors alternately apply almost the full 9V supply across each main primary winding, which voltage is stepped up by the multi-turn secondary winding. A small centre-tapped feedback winding provides the bias voltage for the transistors. The converter transformer is the same as that used in the Capacitor Insulation Tester published in November 1971 (File No 7 / CM / 6).

The square-wave AC voltage from the secondary winding is rectified by a half-wave voltage-tripler consisting of three diodes and three capacitors. With no load connected and depending on the condition of the battery, the voltage developed can be anywhere from 500 to over 600V.

To enable the same open-circuit voltage to appear at the Checker's terminals at each test, we have an adjustable bleed resistor across the high voltage supply consisting of 470k 1W resistor and a 5M potentiometer connected as a rheostat (variable resistor). This enables the Checker to be used at battery voltages down to 8V.

Adjustment of the Checker for 500V open-circuit voltage is achieved by connecting a jumper lead across the output terminals and setting the 5M potentiometer for full-scale deflection of the meter. This ensures consistent results as the battery ages. When the meter pointer can no longer be brought to FSD (zero), the battery should be replaced.

The mode of measurement is as follows: The 500V from the converter is applied to the load terminals via a 2.2M 1W resistor. The current which flows through the load is monitored by a 100uA FSD meter shunted by a 680 ohm resistor. Maximum current flows when a short circuit is placed across the output terminals and this is indicated by the meter as zero ohms. Higher resistances




*A standard diecast box from STC houses our Insulation Checker. The meter is a 100uA movement and the scale made with the aid of Letraset. The knob is used to set the pointer to FSD with the output terminals shorted.*

are indicated accordingly, up to and beyond 30 megohms.

Note that unless the insulation resistance of the device being measured is extremely high, the voltage across the output terminals will be less than 500V. Also if you attempt to measure the Checker's output voltage with a VTVM with input resistance of 10 megohms, or a 20,000 ohm / volt meter on the 500V range (which also results in a 10 megohm load) this will yield a voltage reading of only just over 400 volts. Both effects are because the effective output resistance of the Checker is 2.2M.

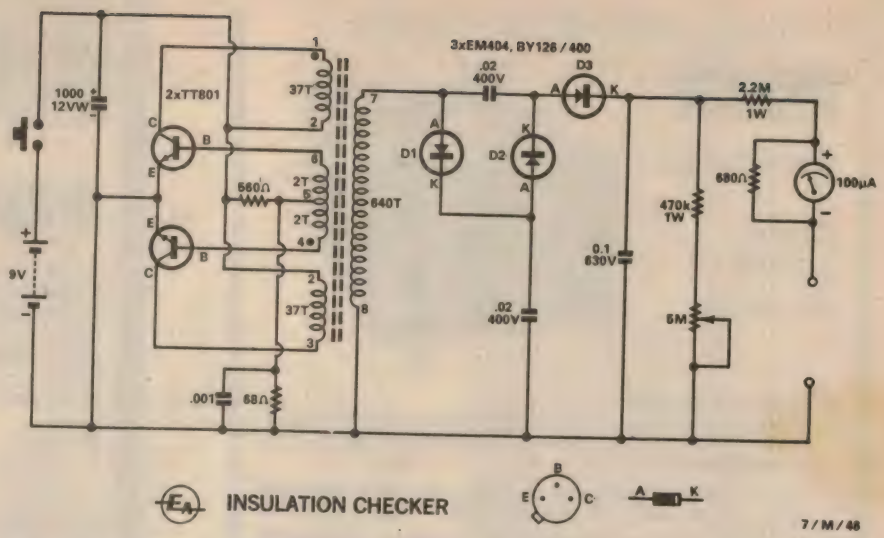
## CHECKER PARTS LIST

*1 diecast box, 120 x 95 x 55mm, with internal slots (STC)*
*1 moving coil meter movement, 100uA sensitivity*
*1 SPST miniature push-button switch*
*2 banana plug sockets*
*1 metre of miniature figure-8 flex*
*2 banana plugs*
*2 alligator clips*
*1 Eveready 2362 9V battery plus snap-on connectors*
*2 FX2240 Ferroxcube half-cups, with DT2179 bobbin to suit half-cups, or converter transformer (RCS part no 130)*
*2 TT801, AY8139 or similar silicon NPN transistors*
*3 EM404, BY126 / 400 or similar silicon 400V diodes*
*1 1000uF / 12VW electrolytic capacitor*
*1 0.1uF / 630V polyester capacitor*
*2 .022uF / 400V polyester capacitor*
*1 .001uF / 50Vpolystyrene or ceramic capacitor*

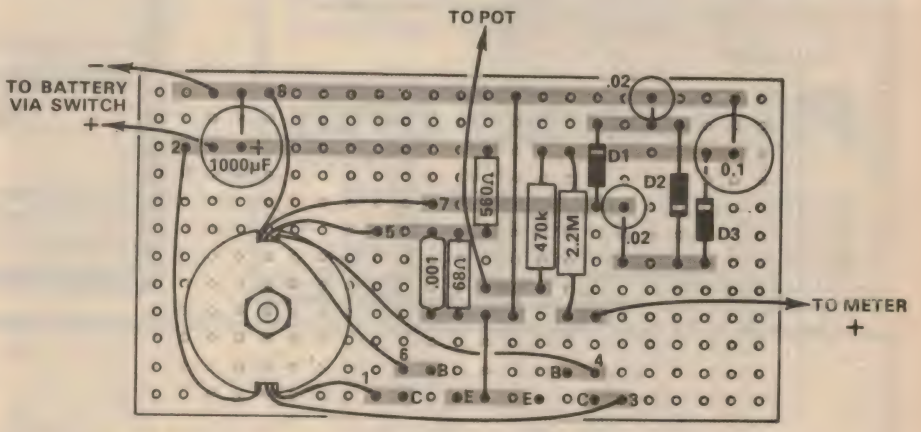
*RESISTORS*
*(¼ or ½W, 5pc tolerance unless otherwise noted)*
*1 x 68 ohm, 1 x 560 ohm, 1 x 680 ohm, 1 x 470k 1W, 1 x 2.2M 1W, 1 x 5M (lin) potentiometer*

*MISCELLANEOUS*
*4 rubber feet,*
*1 piece of Veroboard, 0.15in hole spacing, 90 x 48mm,*
*26 and 38B&S DTE copper wire,*
*Aluminium for battery clamp,*
*Varnished cambric sleeving (spaghetti),*
*Hook-up wire, screws, nuts, washers, solder, paint.*

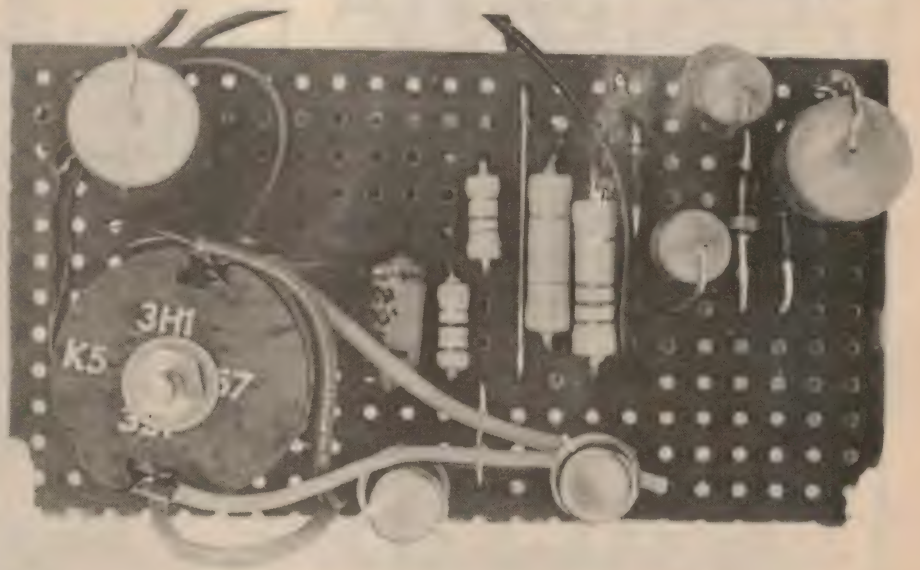
*Note: resistor wattage ratings and capacitor voltage ratings are those used for our prototype. Components with higher ratings may generally be used provided they are physically compatible. Components with lower ratings should not be used.*




*An inverter driving a voltage-tripler rectifier provides a nominal 500V DC for the Checker.*




*Most of the components are mounted on a piece of Veroboard which slides into the case.*



This order of resistance is a compromise and is required to protect the meter and converter against short-circuits across the output. Note that if the resistance was reduced, the meter scale would be more cramped at one end — at present the centre-scale reading is approximately equal to the output resistance, ie, 2.2M.

Thus, a 2.2M resistor connected across the output terminals of the Checker will have only half the available supply voltage impressed across it, it, 250V approximately. Similarly, a 1 megohm resistor will have approximately only 150 volts impressed across it.

While the lower voltage across loads of a few megohms is not necessarily ideal, the voltage is still sufficient to show any insulation defects. After all, an electrical appliance should have an insulation resistance of many megohms. The only likely exceptions to this will be found with immersion heaters and washing machines, which may be only 1 megohm or so.

Current drain of the Checker is of the order of 70 milliamps, but since its use will be intermittent, the battery can be expected to last for almost its "shelf life". We used an Eveready 2362.

## CHECKER

A standard diecast box measuring 120 x 95 x 55mm is used to house the Checker. We used one from STC which has internal slots to mount component boards. All the necessary holes are drilled in the case and it is painted and labelled as required. We used Letraset rub-on lettering.

Most of the components are mounted on a piece of Veroboard measuring 90 x 48mm with 0.15in hole spacing. This slides neatly into the slots in the case, dividing it into two compartments. The meter and board components occupy one compartment while the battery and the remaining components occupy the other.

The two silicon transistors may be TT801's as specified on the circuit diagram or 2N3053's or AY8139's which are more expensive. The transistors run at light load and do not require heatsinks. Note that one transistor has its base lead bent to fit into the Veroboard.

All the capacitors are mounted "standing up" to save space. Take care to mount them exactly as indicated by the wiring diagram, otherwise they may interfere with the back of the meter. The 470k and 2.2M resistors should be 1W types since they have high voltage applied across them, and ½W resistors are not rated for operation in excess of 350V.

As mentioned earlier, the Checker uses the same converter transformer as used in the Capacitor Insulation Tester featured in November 1971. This transformer is available from at least one supplier, RCS Radio Pty Ltd, of 651 Forest Road, Bexley, NSW 2207, with the type number RCS 130. Alternatively, the transformer can be wound from the details shown in the data panel.

## WINDING THE TRANSFORMER

Order of windings: Secondary, Primary, Feedback.

Secondary: 640 turns, 38B&S DTE. Code start with knot.

Interleave: One wrap of electrical tape or polythene film between secondary and primary.

Primary: 37 turns plus 37 turns, bifilar (wound together), 26B&S DTE.

Place two knots in start.

Feedback: 2 turns plus 2 turns, bifilar. 26B&S DTE. Place three knots in start.

Outer wrap: One wrap of electrical tape.

When winding coils of this type, counting and handling is made easier by clamping the bobbin between two large washers, using a long bolt and nut and rotating this assembly in the chuck of a small hand drill held in a bench vyce. This leaves one hand free to guide and tenstion the wire to obtain an even winding. The washers prevent collapse of the side cheeks of the bobbin as winding proceeds and assist clamping.

Count the number of times the drill chuck rotates for one turn of the handle. Divide this ration into the number of secondary turns. If your drill ratio is 5:1, it will require 128 turns of the handle to wind the necessary 640 turns onto the bobbin.

Take the 38B&S DTE (Double Tough Enamel) copper wire, tie a knot in it about two inches from the end and lay the wire in the bobbin so that the end passes through a deep cheek notch with about three inches to spare. Anchor the start with small piece of electrical tape. Secure the free end of the wire on the drill chuck with ordinary celluloid tape or a rubber band.

Make sure that the wire passes through a deep cheek notch and not a half-depth one, otherwise the wire will build up against this lead for about half the winding and place too high a voltage stress on the wire insulation when the converter is operated.

Proceed to wind the secondary, guiding the wire carefully to keep an even build-up. Finish off the winding with a small piece of tape so that the last turn will come out on the same side as the start. Place one layer of polythene film or electrical tape over the completed winding.

The primary winding is of thicker wire and cannot be conveniently wound with a hand drill. A tighter, more even winding can be obtained with hand winding.

Take two 150cm lengths of 26B&S DTE wire and lay them side by side. Tie two knots in the start end one and twist lightly with the other for about two inches. With the bobbin assembly still mounted on the bolt but placed in the vyce instead of the drill chuck, wind on the required number of turns in the same direction as the secondary winding. Anchor the start in the same way. Avoid twisting the two wires and keep the turns as close together as possible. Count off the turns as though the two wires were one conductor. Anchor the finish with electrical tape.

The feedback winding consists of two turns bifilar wound in the same way as the primary, using 26B&S DTE wire. One start should be designated with three knots.

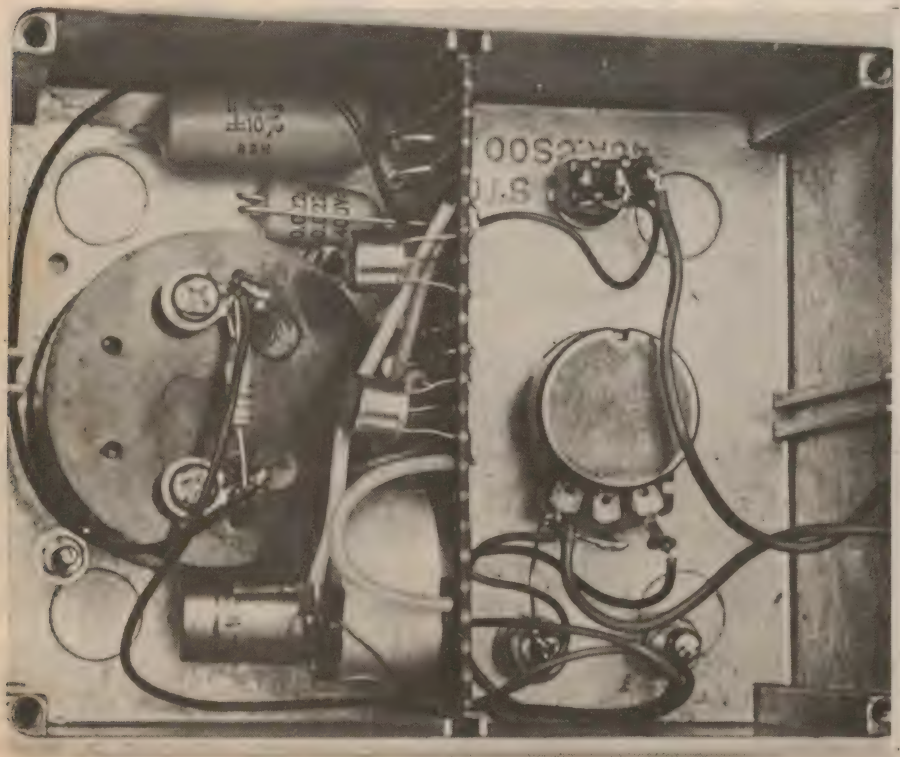
Place a final wrap of electrical insulation tape over the outside of the complete winding.

Before assembling the transformer, the following points should be observed: (1) that there are no traces of foreign matter on the core faces, otherwise the cores can be cracked when they are tightened together; (2) that the secondary leadout wires are laid in the notches provided inside the cores. Inspection of the inside of each core will reveal these leadout notches.

Before finally placing the core halves together, place two pieces of coloured PVC sleeving on each lead of the secondary winding, as close as possible to the bobbin. Use different colours for the start and finish. Suitable small diameter sleeving can be stripped from scrap lengths of thin hook-up wire.

Press the cup-core halves together with the fingers and anchor them with electrical tape around the outside. Clamp the transformer with a 1in long x⅛in Whitworth screw and nut through the core assembly. Use an appropriate washer on either side of the core to prevent undue mechanical stress on the ferrite material.

*Cut away the corners of the Veroboard so that they do not foul the lid of the case.*



A battery clamp should be made from 16SWG aluminium to secure the Eveready 2362 to the lid of the diecast box. The ends of the battery should be covered with insulating tape after the connectors have been pushed on, to avoid the connectors shorting to the case.

If the converter does not operate correctly at switch-on, try reversing the feedback connections — this usually brings forth a welcome high-pitched whine from the transformer. Watch out for the 0.1uF 630V reservoir capacitor — it charges to a high voltage and can deliver quite a nasty "bite".

A new scale will have to be made for the meter movement. This can be done after the rest of the unit is complete and working. Remove the front of the meter movement and carefully unscrew the two screws which secure the scale to the movement. Spray the back of the scale with white paint. After it has dried, draw a suitable arc on the blank face with drawing ink and compass, with same radius as the original scale. Place the scale back on the meter and adjust the potentiometer so that the pointer moves to the end of the scale when the output terminals are shorted together. Now connect 1, 3, 10 and 30 (3 x 10 in series) megohm resistors to the terminals and mark the scale accordingly. Letraset can be used to obtain a neat job.

This completes the description of our solid state Insulation Checker. Some readers may care to combine it with the Capacitor Insulation Tester mentioned above, using a common converter, but even by itself it should be found very useful.

# Post Office 'cops' monitor the airwaves

With about 170,000 radio services operating in Australia, strict control on their operation is essential to avoid chaos. This is the task of the monitoring stations run by the PMG Department — keeping the radio frequency spectrum free of electromagnetic interference.

As a member nation of the International Telecommunications Union, Australia is required to operate a system of stations for monitoring the radio frequency sprectum.

The Australian Post Office operates fixed and mobile monitoring stations in each state. Their jurisdiction is not limited to Australian radio services as they also report to the International Telecommunications Union on reception in Australia of overseas radio services. This information is disseminated to all ITU member countries to assist them in assigning frequencies which will not interfere with other operating services.

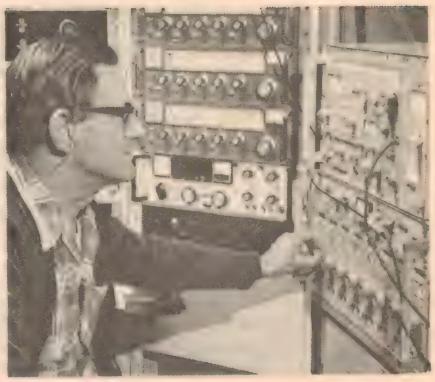
In Australia, the Post Office allocates frequencies to the various radio services and maintains the Australian Master Frequency Assignment Register. An International Frequency List is distributed by the ITU.

Each of Australia's monitoring stations has frequency measuring positions, traffic monitoring positions and frequency standard installations. These stations are fitted with highly accurate equipment to measure operating frequencies, and the frequency standard in each station is regularly calibrated against an atomic standard controlled by the Post Office Research Laboratories in Melbourne.

As well as a regular frequency measuring program, the stations also carry out checks when requested by individual authorities and investigate complaints of interference. Over regular periods, a 24 hour coverage of the frequencies is completed.

All radio services are checked. Commercial radio and television stations, aeronautical services, small ships, non-directional beacons, rural fire brigades, amateur radio stations and mobile radio services are measured and monitored regularly.

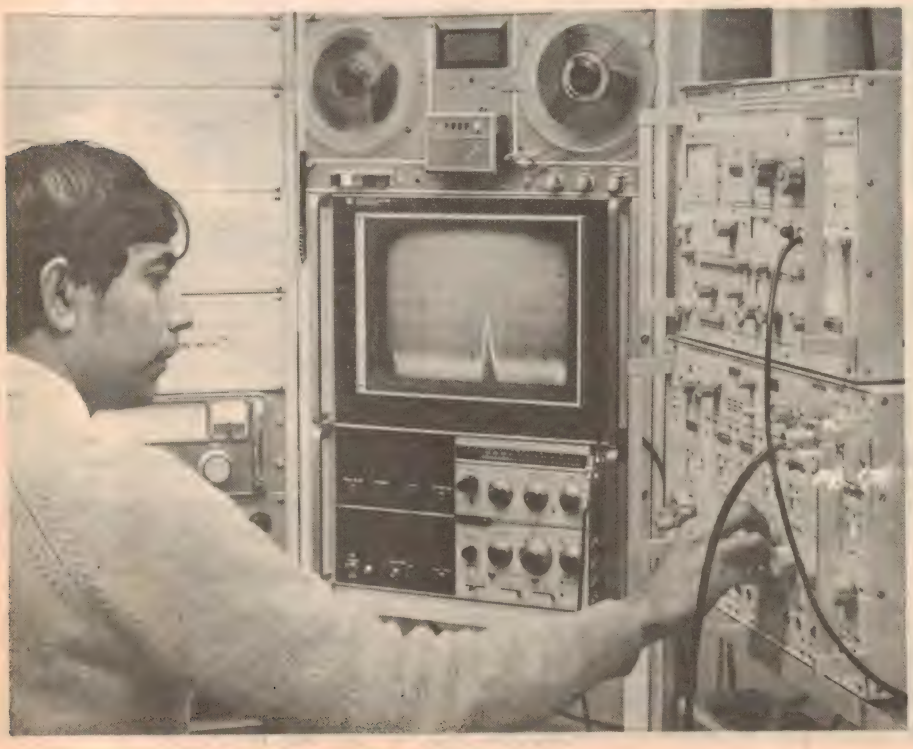
Before any radio station goes on the air its frequency is checked by a monitoring station. When a monitoring station detects a breach of regulations, either technical or traffic, contact is made immediately with the offending station authority and corrective action sought. Unlicensed stations pin-pointed by the monitors are liable to have their equipment confiscated and they may be prosecuted by law.



*As part of a regular frequency measuring program officer Roy Pearce carries out frequency checks on a radio station in Victoria.*

Generally, users of radio services in Australia comply with the regulations controlling their activities on the air, but stations wandering off frequency, spurious signals or poor operator procedures, cause problems for others sharing the airwaves. Often, the breaches are unintentional and a friendly tip from Australia's 'air police' is all that is needed to ensure that the traffic flows once again without interfering with others.

(Courtesy Australian Post Office News).



*At left, monitoring officer Lindsay Labutte uses a spectrum analyser to check out a spurious transmission detected during tests. Above shows measuring officer John Smith comparing the frequency standard of the monitoring station with the atomic standard at the Post Office Research Laboratories.*

# Here's a superb stereo sound source you'll still be proud to own ten years from now.

And it will still be up to date. Of course, you do need to be discriminating, and realise where long term value lies in terms of precision engineering and its relationship to performance. *We suggest you invest wisely in:—*

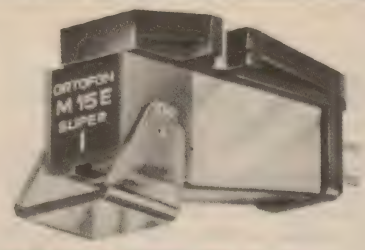
### THE NEW SWISS MADE THORENS MODEL TD 160 TRANSCRIPTION TURNTABLE

ncorporating the radical new Thorens TP 16 tone arm — *the arm overseas reviewers have enthused over* — the Thorens TD 160 offers unrivalled engineering at a most attractive price. A 16-pole two-phase synchronous motor and belt drive combined with a dual chassis suspension system provide a wow and flutter figure of 0.06% according to DIN 45507, weighted. *This is a remarkable figure in anybody's language.*

The platter of the TD 160 is of non-magnetic zinc alloy, 12" in diameter and weighing 7 lbs. Two speeds are standard — 33⅓ and 45 rpm. Stray magnetic flux has been minimised so that even the most sensitive cartridges may be used with the TD 160 without incurring problems with hum induction.

Bearing friction of the revolutionary Thorens TP 16 tone arm has been reduced to less than 20 milligrams in both planes measured at the stylus tip.

Your Bleakley Gray dealer will be pleased to demonstrate the all-new Thorens TD 160 transcription turntable. No doubt he'll also show you the superb **Thorens TD 125 Mk. II** electronic transcription turntable, a three-speed model which is undoubtedly *the most sophisticated turntable manufactured in the world today.* The TD 125 Mk. II has many superior features and naturally costs more than the TD 160. Both Swiss made Thorens turntables offer *long term reliability* and an *extraordinary standard of performance.*




### SELECT AN ORTOFON STEREO CARTRIDGE.

From Denmark comes the new Ortofon M15 Super Stereo cartridge, recognised as the *lowest distortion cartridge in the world.* The magnet design of the M15 Super is quite unique. Signal currents are generated on the most linear portion of the magnetic transfer curve. There are no moving magnets, nor conventional magnetic gaps.

This Ortofon cartridge is a ailable with an elliptical or conical diamond stylus. Both stylii are replaceable.

Frequency response of the M15 E Super is 20 Hz to 20 kHz, this figure varying only 1 dB up to 10 kHz. The same figure applies to the M15 Super with the conical stylus. Channel separation is 25 dB and recommended tracking force is 1 gram.

Ortofon's new extralinear magnetic circuit employed in the M15 Super Series reduces *tracking* and *tracing* distortion, *frequency* and *phase* distortion as well as *harmonic* and *intermodulation* distortion to the lowest level ever available in a magnetic stereo cartridge. **The result is extraordinary fidelity and musical clarity.**

### USE WATTS EQUIPMENT TO KEEP YOUR RECORDS CLEAN.

Few music lovers realise the damage that airborne dust and dirt can do to a valuable record collection. Not only do these factors contribute greatly to reproduced *noise* and *interference* — the actual wear on the record can be *considerable.* Watts record maintenance equipment solves most of the problems. *We recommend:*

**THE WATTS "MANUAL PARASTAT" Mk. IIA.**
This is a dual-purpose record cleaner designed to **maintain** *new records in new condition* and to *restore fidelity to older discs.* Use immediately prior to playing.

**THE WATTS "DISC PREENER".**

Designed expressly for records which have not had previous anti-static treatment. The **"Disc Preener"** keeps *new records like new.*

**THE WATTS "DUST BUG". (Illustrated.)**

This effective device cleans the record, removing dust and static charges as the record *actually plays.* Surface noise can be reduced considerably with the **"Dust Bug".** This item should be used *every* time you play a record, for the sake of both *records* and *stylus.*

***See your nearest Bleakley Gray dealer. He'll help you create a stereo sound source you'll still be proud to own ten years from now!**

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## *Part two of our state-of-the art project:*

# LSI Digital Clock

**by LEO SIMPSON**

Here we present the remainder of the construction procedure to build your state-of-the-art electronic digital clock. Hurry and obtain your kit while the special introductory offer lasts!

Readers should note that the special introductory kit offer of $22.55 plus tax is limited. After it runs out, all the major components will be available from NS Electronics Pty Ltd distributors but not at the special offer price.

The colour of the clock case should match the decor of the room where it will be on display. We used a spray can of touch-up lacquer called "Chrysler Hot Mustard" which is currently a popular car colour. While the paint dries and hardens — let it stand over night — the boards can be assembled.

Start with the smaller board. With a hacksaw, carefully cut a piece off one end of the board. The cut should clear the hole marked "19" by 3 or 4mm. Don't worry about cutting the copper conductors to the left of this hole (looking at the copper side). They are for the time-setting switches, which we wire up directly rather than via the board. Now insert the pin connectors for the Sperry display. Note that five of the connector holes have no connection to the circuit, so they may be left out. They are for the AM and PM electrodes which are not used with the MM5314 circuit. Finally push a pin into each connector to open it up slightly.

With the pin connectors and the 10 megohm resistor soldered in, now start on the other board. It must be drilled to take the mounting lugs of the special A & R transformer. Drill the two holes carefully so that none of the essential copper pattern is damaged. Components may now be installed.

First, insert all the resistors and solder them. Ideally, ¼W resistors should be used wherever specified, as the board has been designed to take them, but ½W types will fit in — just. Do not bend the leads too close to the resistor body. Now insert the two integrated circuit connector strips and solder them. Snap off the top portion of each strip **after soldering** so that each little connector is now isolated from its neighbour. Having done that, remove the pin connector for pin 11 of the IC. This allows operation at 50Hz instead of 60Hz. Then push a pin into each connector to free them up slightly.

The integrated circuit is supplied with the pins pushed through a black conductive foam material into a piece of polyurethane foam. This is to protect the MOS integrated circuit against build-up of static charges, which can do permanent damage. Do not unpack it or install it in the circuit until the rest of the circuit is complete, or the result may be very costly.

The next step is to solder in all the capacitors except the three large electrolytics. Metallised capacitors should be used where specified, as ordinary polyester capacitors are too large. The diodes may be installed at this stage, taking care to observe correct polarity. Again, do not bend the leads too close to the body, otherwise you'll end up with broken diodes.

Now solder in the transistors. In the place of the "A20" on the board, next to the 390pF capacitor, install the TO-92 plastic encapsulated transistor marked with a green dot. In place of seven "H55" transistors in a line towards the top of the board immediately above the "Sperry" symbol, install 2N2905A or 2N2907A transistors. Similarly, the four "H55" transistors located in a line near the centre of the board (refer photograph) are replaced with 2N2907A or MPS3645. Do not use 2N2905A's here, as the spacing is too close for their larger TO-5 metal case.

Note that the two "H55" positions near the edge of the board and the associated 22k and 1k resistor positions are unfilled, unless the optional seconds display is required.

One 2N2905A marked with a red dot replaces the "H55" transistor located near the corner of the board, adjacent to the 470uF electrolytic capacitor. This transistor functions as the colon driver for the display. It is a specially selected device and cannot be replaced by an unselected device.

We soldered the fuse directly to the broad, with the aid of wire links. A more elegant method would be to use two McMurdo fuseclips, with one of the solder lugs clipped off each. Alternatively, a length of appropriate fuse wire could be soldered directly to the board, but this is not recommended except as a temporary expedient.

The transformer may now be mounted. Take care when bending the six leads to suit the appropriate holes. Make sure the transformer is firmly bedded down on the board before twisting the lugs to secure it. Solder without applying excessive heat. Now solder in the 470uF electrolytic capacitor, which must be a printed circuit type (not pigtail type) if it is to fit in the case.

Now solder in the interconnecting wires. The active, neutral and ground connections may be ordinary insulated hook-up wire, about 10cm long, while lighter gauge hook-up wire of as many different colours as possible should be used for the display connections. If you are limited in wire colours, use a repeating colour series, such as RBGRBG, to lessen confusion. Connections 8, 9 and 10 are made with dual shielded cable (figure-8), whith both shields connected to "8". All these connections, 1 to 19 need to be about 20cm long. Leave out wires 12 and 13 unless the SECONDS display is required.

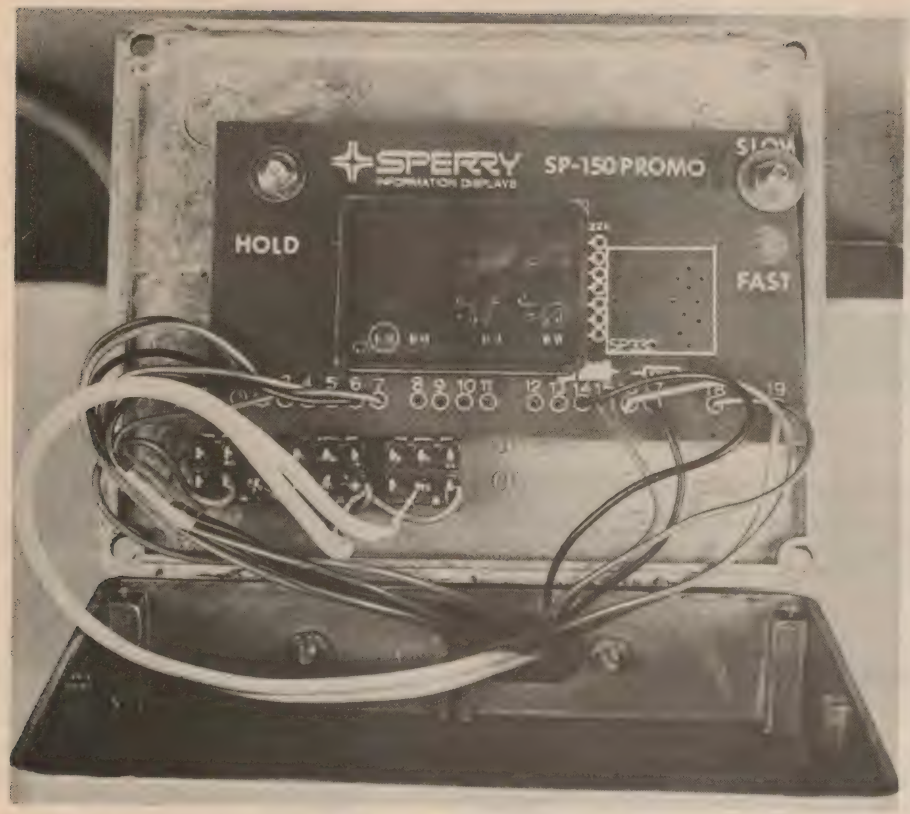
The remaining two large electrolytics present a problem in that the board was designed to take a dual-capacitor printed circuit mounting can unit. This just isn't available in Australia, to our knowledge. The two electros to replace it are mounted horizontally with spaghetti sleeving on their pigtails, as follows: Remove the .02uF capacitor near the edge of the board and adjacent to the fuse. Now solder in the 47uF capacitor with the negative electrode connected to the vacated hole (for the .02uF) furthest from the fuse.

The 33uF electrolytic capacitor is soldered to the appropriate connections marked plus and minus. Note that although values marked on the board are 50uF and 30uF, constructors are more likely to be supplied with the "preferred" range values of 47uF and 33uF. The tolerance on electros is so large that the nominal difference in value is unimportant.

Resolder the .02uF capacitor into position but on the copper side of the board. Carefully check the board for quality of the solder joints and breaks in the copper pattern. Assembly of all the components on the lid can now take place.

First, mount the "leads" end printed circuit bracket. It is secured with two screws which also hold the two rubber feet at that end. Insert the board into the bracket and mount the other bracket. Attach the mains cord with the aid of a cord clamp. The screw for the cord clamp also secures one of the rubber feet. The active and neutral wires from the mains cord and board are terminated in the two-way terminal block. The earth wires are attached to the solder lug.

Now solder the interconnecting wires to the display board, by passing each one, in turn, through the holes in the cases and soldering it. In this way, the job can be done systematically with no need to resort to a multimeter to find out which is which. Wires 8, 9, 10 and 11 are not soldered to the board but to the switches installed on the lid. Wires 12 and 13 have been deleted, as noted earlier. The shield of the figure-8 shield cable is a common connection for the three switches. If you have switches which have more than one set of poles, you will need to




*Inside the top section of the case. All the leads should be kept as short as possible.*

determine with a multimeter switched to the "ohms" range which pair of contacts are normally "open".

Note that while the FAST and SLOW time-setting switches should be normally open SPST push-button types, the HOLD switch can be a pushbutton, slide, rocker or toggle.

Having completed the interconnections, check them carefully and insert the integrated circuit into its socket. The notched end of the IC should be closest to the power transformer. Check that each individual connector is not touching its neighbour. The lid can now be screwed to the base.

When mounting the Digibezel, take care to install the polaroid filter with the right side facing out. The back clamping plate is installed with the large "knobs" putting pressure on the rear of the front panel. If you do it the other way around, the bezel will be a sloppy fit. The four push-on fasteners hold the bezel in place. They are installed with the aid of pliers. Take care to assemble the bezel correctly on your first attempt, because the push-on fasteners are very hard to remove without damage.

Some constructors may consider the polaroid filter cuts out too much light from the display. They may wish to substitute red perspex for the filter. However, we felt that the light output was adequate for most domestic situations and the polaroid filter is more attractive in appearance than perspex. It does not allow the un-illuminated cathodes of the display to be seen, whereas they may be visible with perspex.

Push the Sperry display carefully into the readout board connectors, taking care to see that each pin mates properly with its connector. Using nuts and washers either side of the board, mount it so that it is spaced approximately 8mm from the lid surface. Wires 1 to 7 can be laced loosely together, but wires 14 to 19 should be kept as far apart as possible from each other and from the shielded cable. The lid may be secured temporarily with two screws, making sure that none of the leads are pinched or interfere with the display. Now turn on the power.

The display does not light up instantly but in a few seconds will come on in a random fashion with some digits and or segments unlit. Sometimes the display does not light up at all but this is not necessarily a malfunction. Press the HOLD and then the FAST switch and the display should rapidly run forward. Set the time approximately and use the SLOW button to set the time exactly. Monitor the clock over a few hours to see that it does not gain or lose time. If it does it is generally because the interconnecting leads to the two boards are too close together, causing spurious "cross-triggering".

If one segment of a particular digit will not light up it is because of a bad connection on the back of the display. If one particular segment on all digits will not light up it will be because of bad connection or faulty "segment driver" transistor. This will usually be easily found by checking with a multimeter switched to the ohms-range across collector-emitter of the suspect transistor, which will most likely be shorted. Segment driver transistors are in a line towards one side of the board.

Similarly, if one digit does not light up at all, it may be because of a bad connection or faulty "anode driver" transistor. These are in a line near the centre of the board. At a pinch, if one of these eleven transistors has gone it may be possible to restore operation by replacing it with a TT800 though note that, strictly speaking, its voltage rating is insufficient. Other component substitutions should not be made unless there is no shadow of doubt as to their suitability.

Note that in normal operation the transformer will be quite warm to the touch.

## FOR THE RECORDING ENTHUSIAST:

# Tests on parabolic microphone reflectors

Parabolic reflectors are often used in an attempt to obtain improved directivity from microphones. Frequently the design approach adopted is a rather intuitive one, and the results may be disappointing. This article analyses the effects on performance of reflector material, size, focal length, and microphone size and position.

by PROFESSOR G. N. PATCHETT, Ph.D

University of Bradford, UK

A parabolic microphone reflector is often dismissed as a device which reflects the sound waves on to the microphone and hence increases its sensitivity and makes it highly directional. Unfortunately, this is a very simplified picture of a very complex problem bringing in the effects of reflection, diffraction and interference. The normal arrangement of a parabolic reflector and microphone is shown in Fig 1, the microphone being situated at the focal point of the reflector and facing into it. The parabola has the property that the distance AB + BC is a constant whatever the angle BC makes to the axis. Thus all sound waves travelling as a plane wave will arrive after reflection at the microphone at the same instant, ie, in phase.

The difficulties of the reflector arise because of the large range of frequencies over which the reflector should operate, eg, 100 to 20,000Hz, a range of 200:1; and because the size of the reflector is comparable in size to the wavelength at some frequencies. Parabolic reflectors are, of course, commonly used for light and microwaves but these problems do not arise. Considering visible light, the wavelength is from, say, 400 to 700nm, a corresponding frequency range of less than 2 to 1. The wavelength of the light is, of course, extremely small compared with any normal reflector. Similarly, when dealing with parabolic aerials the range of frequencies is small and the wavelength of the radiation is small compared with the dimensions of the aerial.

There are many possible variations when dealing with the performance of reflectors, some being size of reflector, focal length, material, size of microphone and type of microphone, eg, omnidirectional or unidirectional. Many statements have been made about the effect of some of these but I felt that scientific measurement of the effects of some of the variables would be valuable.

Unfortunately, acoustic measurements are difficult to make because there is no perfect sound source and one is troubled by reflections. Most of the tests have been done in an anechoic chamber but such chambers have their limitations, and the one used was small for this purpose. Some measurements were made in the open but then difficulties arise due to wind, noise and reflections. Some errors occurred due to difficulties of aligning the reflector accurately onto the sound source.

Before reading details of the tests and results, consider what is an ideal reflector. It should have a uniform frequency response over the range concerned, a narrow plar diagram that does not change with frequency, a good forward to backward ratio and also be as small and light as possible. These factors are largely covered by considering the frequency response and polar diagram of various reflector-microphone combinations.

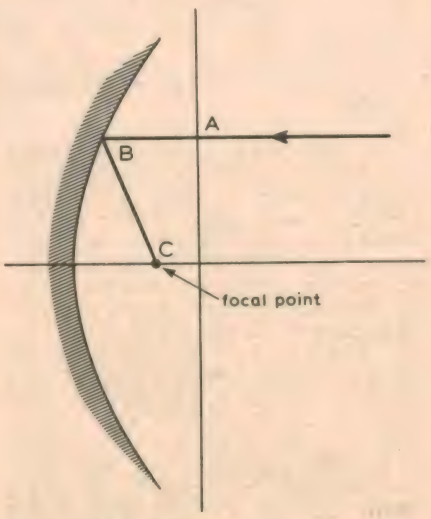



*Fig 1: The difficulty with a parabolic reflector arises because reflector size is comparable to wavelength at some frequencies.*

The overall frequency response does, of course, depend on the microphone, and to eliminate the frequency response of the microphone, the results given are those obtained by subtracting the response of the open microphone from the response of the same microphone in a reflector. Thus the response curves show the change in frequency response of the microphone when used with a reflector. There are a number of difficulties in making these measurements and most were made in an anechoic chamber. Unfortunately, there is no perfect sound source giving a uniform response over the whole audio range.

The normal method of overcoming this difficulty, when determining the frequency response of microphones, is to use a standard microphone to control the output of the loudspeaker, so that the sound level at the standard microphone is constant. By placing the standard microphone near to the microphone on test, it can be assumed that the sound level on the test microphone is also constant. This technique cannot be used with a microphone in a reflector because the standard microphone cannot be placed near to the test microphone, as it would be upset by the reflector.

Accordingly, a standard microphone was used, with feedback to maintain a constant level at the standard microphone, but this was placed well away from the reflector. The sound level at the test microphone could not be assumed constant, but provided changes were not made in the positions of the microphones, the sound radiated in the direction of the test microphone would remain the same, with or without reflector. Hence the change in frequency response by adding a reflector would be correct.

It is common practice to use a number of speakers with crossover networks to cover the whole frequency range. It was soon realised that such a sound source would not be satisfactory, as the sound at different frequencies comes from different places and when dealing with the microphone and reflector which is highly directional this would lead to errors. Hence, eventually a Tannoy speaker was used where the tweeter is situated behind the cone and the cone is used as the horn of the high frequency unit.

The first consideration was the effect of the material of the reflector. Response curves were taken on a 24-in aluminium reflector and a 24in fibreglass reflector, both having a 7in focal length. These gave identical responses and it was concluded that changing the material from metal to

fibreglass had no appreciable effect.

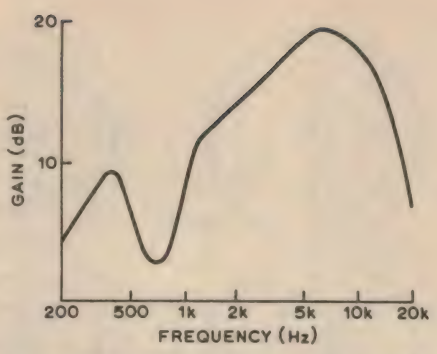
The effect of such a reflector, using a Grampian DP6 omnidirectional microphone, is given in Fig 2, and varies greatly with frequency. The gain is poor at low frequencies because the wavelength of the sound wave is comparable to or greater than the dimensions of the reflector. At 200Hz the wavelength is about 5.6 feet and hence diffraction rather than reflection takes place. The large dip of about 7dB at 600-700Hz is thought to be due to cancellation of the reflected wave by the direct wave. As the microphone is omnidirectional, it will pick up the direct wave and the reflected wave, after travelling to the reflector and back. The difference in distance is twice the focal length, 14in, corresponding to half a wavelength at a frequency of approximately 500Hz, which does not agree exactly, probably because the microphone is not a point source.

One might expect that the gain would continue to increase at high frequencies whereas, in practice, the response drops rapidly above about 10kHz. This is assumed to be due to interference effects when the wavelength is comparable with the size of microphone. Wavelength at 10kHz is 1.3in which is of the same order as the size of the microphone. Maximum gain is about 20dB which is well worthwhile and occurs at about 5kHz.

If the drop in response at high frequencies is due to the size of microphone, then it can be reduced by using a smaller microphone. This was confirmed by the use of a Sony ECM50 which is only about ⅜in diameter and ¾in long. In this case the peak was at about -10kHz and the maximum gain was about 22dB.

The next factor to be considered was the size of reflector, and two other fibreglass reflectors were constructed exactly similar to the 24in reflector (ie 7in focal length) but of diameter 18 and 12in. Fig 3 shows the change in response, using the same microphone and two reflectors. Considering first the 18in one, the gain is now less at low frequencies as would be expected but the maximum gain is not changed much. The dip occurs at the same frequency and the magnitude of the dip is approximately the same. However, due to the low gain at low frequencies, the bottom of the dip gives a response which is less than that of the open microphone. The 12in reflector results in still less low-frequency response and a response at 700Hz which is much less than that of the open microphone. The maximum response is now reduced appreciably.

The next variable to be considered was the focal length and a fibreglass reflector was made of 24in diameter and 4in focal length. This results in a much deeper reflector which is heavier and more difficult to carry. The response, using the same DP6 microphone, is given in Fig 4. This is similar to the 7in focal length as regards low-frequency response and maximum gain but there is no appreciable dip. If the dip is caused by interference between direct and reflected waves, then it would now occur at 900Hz. There is some reduction at this frequency but nothing like the reduction which occurs with the reflectors of greater focal length. I do not know why. The deeper reflector therefore has the advantage of a more uniform response and it also has the advantage of protecting the microphone from the wind to a greater extent than the shallower reflector.



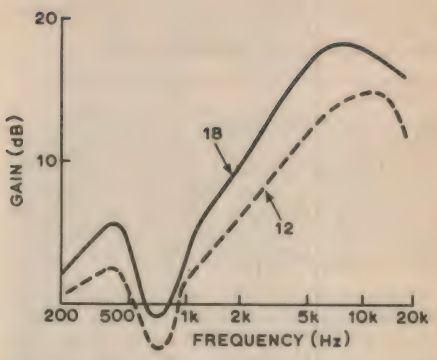
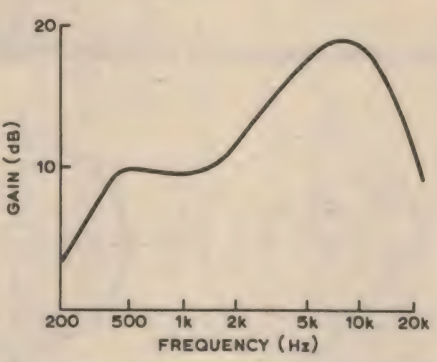




*Fig 2 (left): Frequency response of omni-directional DP6 microphone in 24in diameter reflector of 7in focal length. Fig 3(right): Frequency response of DP6 microphone in 18 and 12in diameter reflectors of 7in focal length.*



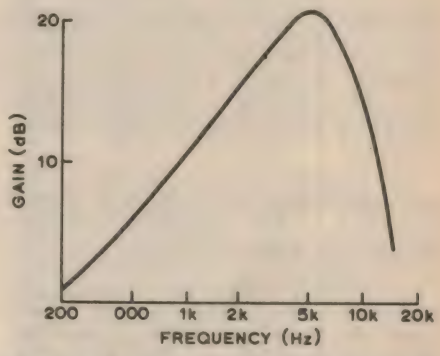




*Fig 4(left): Frequency response of DP6 microphone in 24in diameter reflector of 4in focal length. Fig 5(right): Frequency response of M69 cardioid microphone in 24in diameter reflector of 7in focal length.*

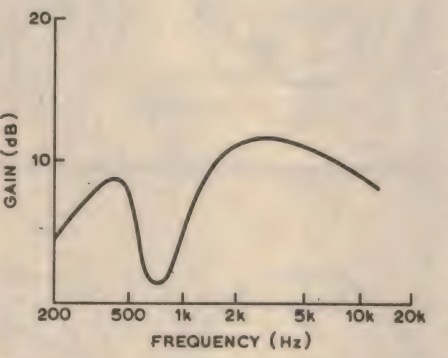



*Fig 6: Frequency response of DP6 microphone in 24in diameter reflector of 7in focal length with sound source 10 degrees off axis.*

If the dip is due to interference between direct and reflected waves, then it should be largely removed by using a directional microphone such as one with a cardioid polar diagram. The effect of using a Beyer M69 microphone which has a cardioid polar diagram is given in Fig 5 when used in the 24in-diameter, 7in focal length reflector. The response at low frequencies is now very poor. In the case of the omnidirectional microphone, even if there are no reflected waves, the response at low frequencies will be the same as without a reflector because of the use of the direct sound waves. With the cardioid microphone the pick up of direct waves will be negligible (say —20 to —30dB) and hence the only output is that due to the reflected wave which is small. There is now no dip as there is no appreciable interference between direct and reflected waves, owing to its low response to direct waves.

The peak occurs at about the same frequency, namely 5kHz, and the maximum gain is about the same as the DP6. However, the response drops off very rapidly at high frequencies for reasons not known. The same microphone was tried in the 24in diameter, 4in focal length reflector and very similar results obtained, but with slightly greater gain at low frequencies (1 to 2dB). A Sony ECM21 (Electret) microphone, which also has a cardioid response, was tried with similar results but better at high frequencies, presumably due to its smaller size.

In all the above cases the microphone was placed at the focus of the reflector. Changing the position along the axis does not alter the frequency response appreciably but, as shown later, does alter the polar diagram. In all the above cases the sound source was on the axis of the reflector and the response changes rapidly for sources off-axis. The response of the DP6 microphone in a 24in diameter 7in focal length reflector is shown in Fig 6 when the sound source is only 10 degrees off the axis. This should be compared with Fig 2 taken on the axis under the same conditions. The response is approximately uniform apart from the dip at 700Hz. Maximum response is now less than that on the axis by some 10dB. Thus the frequency response and sensitivity obtained depend greatly on the accuracy of aiming. If the reflector is used for bird recording and there are a number of birds spaced apart, then the frequency response will be different for the different birds.

Response curves were also taken in the open air and they had the same general characteristics. However, I found it impossible to obtain steady readings at the

## Microphone Reflectors

high frequencies where the reflector is very directional. This was due to the slight wind which tilts the wavefront so that, as far as the reflector is concerned, the sound appears to be coming of axis. In practice, if there is any wind, the frequency response will change continuously and often rapidly.

Polar diagrams were obtained using the anechoic chamber and rotating the microphone-reflector assembly. The shape of polar diagram depends very much on the frequency at which it is taken. Diagrams at a number of frequencies are given in Fig 7 for a DP6 microphone in a 24-in diameter 7in focal length reflector. These have been drawn with the response on axis the same at all frequencies but, of course, they will be of different amplitude according to the frequency response of the microphone. These curves are actual polar diagrams and include the effect of the microphone polar response.

With the DP6 the polar response of the microphone itself is substantially omnidirectional. At low frequencies the reflector has little effect and the response is almost omnidirectional. It is not until a frequency of, say, 2kHz is reached that the reflector-microphone combination becomes directional. At a frequency of 6kHz the response becomes highly directional and the output drops approximately 15dB when 10 degrees off axis. There is generally an increase in response in the backward direction, relative to the sides, due to diffractior round the reflector.

A 24in diameter reflector with a focal length of 4in gave similar polar responses although the response in the backward direction was reduced as might be expected, the deeper reflector shielding the microphone more. The sharpness of the response in the forward direction was rather less, in general, than that of the 7in focal length reflector. In these diagrams all the minor lobes have not been shown but have been smoothed out, as these are likely to change with small changes of frequency and, in some cases, are too numerous to draw on small diagrams.

As the size of the reflector is reduced the polar diagrams become more omnidirectional, particularly at low frequencies, and diagrams are given for the 12in reflector of 7in focal length in Fig 8, using the DP6 microphone. At high frequencies the differences are not as great, but the smaller reflector does not give as great a suppression in other than the forward direction or, looking at the other way, does not give as great a gain in the forward direction. This is to be expected from the frequency response curves.

In Fig 9 are shown the polar diagrams of a cardioid microphone (M69) in a 24in diameter reflector of 7in focal length. This combination gives sharper polar diagrams, particularly at low frequencies. However, at 250Hz and lower frequencies the response is greater in the backward direction than the forward. It must be remembered that the microphone itself is pointing in the backward direction, ie, it has its maximum response in that direction. Thus at low frequencies, where the reflector has little effect, the response tends towards that of the microphone itself. This is an obvious disadvantage if there are low frequency interfering sounds at the back of the reflector. The responses of this microphone in a 24in diameter, 4in focal-length reflector were similar but with suppression of the response at the sides and back being rather better.

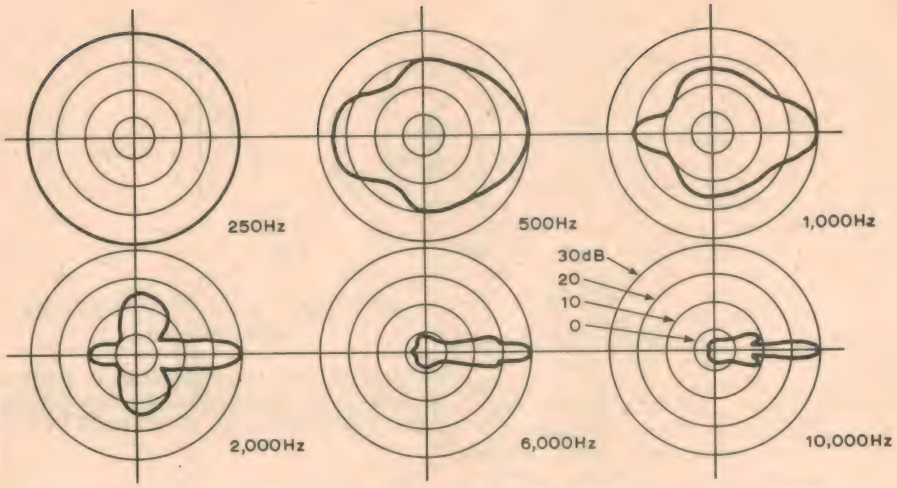



*Fig 7: Polar diagrams of DP6 microphone in 24in diameter reflector of 7in focal length.*

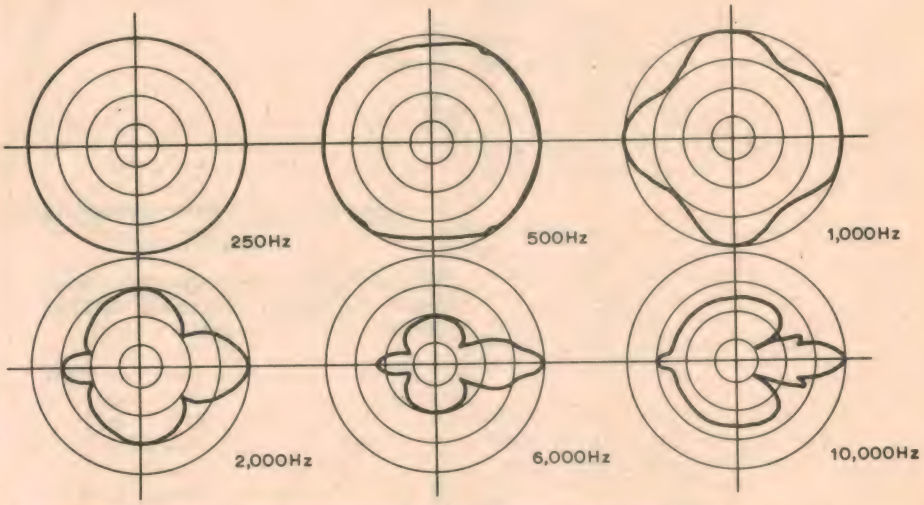



*Fig 8: Polar diagrams of DP6 microphine in 12in diameter reflector of 7in focal length.*

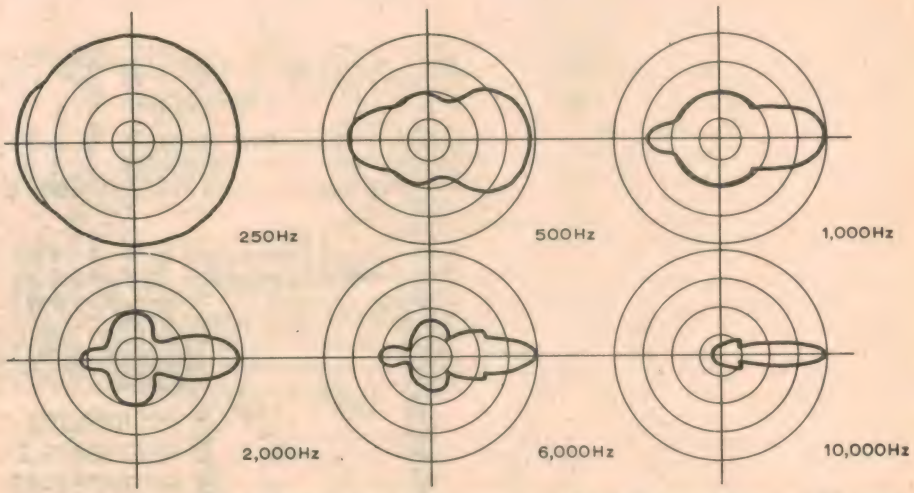



*Fig 9: Polar diagrams of M69 cardioid microphone in 24in diameter reflector of 7in focal length.*

The effect of moving the microphone on the axis away from the focal point is large and is shown in Fig 10. These are taken at 4 and 8kHz for the DP6 microphone in a 24in diameter, 7in focal-length reflector. If the microphone is not placed at the focal point, the sharp polar diagram is destroyed with

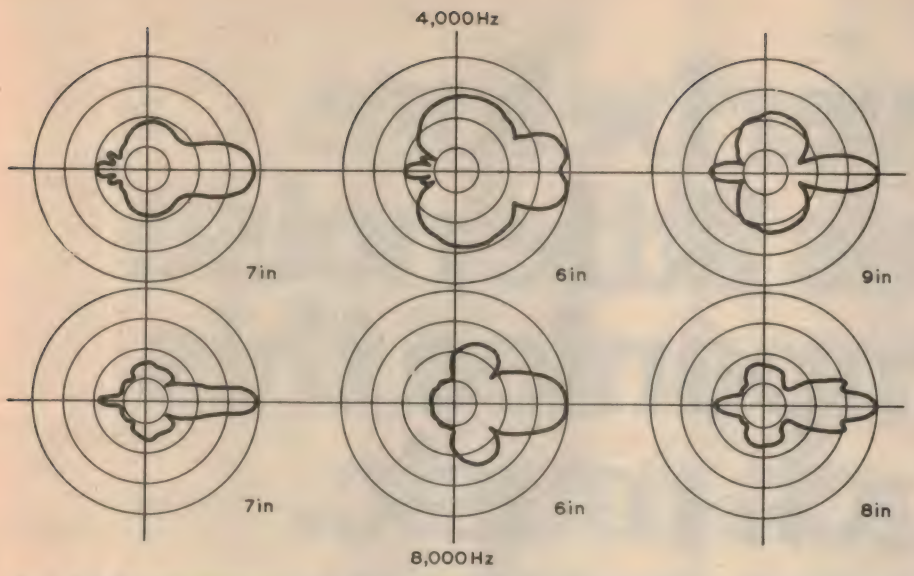



*Fig. 10: Polar responses of a DP6 microphone in a 24in diameter reflector of 7in focal length with the microphone at different distances from the reflector.*

the introduction of side lobes.

It is obvious that some distortion of the sound will occur when using a reflector, the amount depending very much on what is being recorded. Frequency distortion will be greatest when a large range of frequencies is involved, there being considerable loss of low and very high frequencies. How important this is depends on the application.

Reflectors are commonly used for wild life recording, particularly of birds. Many birds have a song at high frequencies and hence the loss at low frequencies is not so important but some harmonics may be lost due to the reduced response at very high frequencies. I did some tests to determine if the distortion was audible.

Recordings of birds were obtained using an open microphone. These were then played in an anechoic chamber, using a high-quality loudspeaker, and the resultant sounds were picked up by various microphones and microphone-reflector combinations. The difference is only slight for birds with a high-frequency song but is very noticeable in the case of birds with a relatively low-frequency song. One recording was made of a chaffinch and Canada geese. When a reflector is used, the relative levels change, the chaffinch song being increased relative to that of the geese, and the sound of the geese is appreciably changed and becomes much thinner.

It should be possible to correct for this response, say after recording, by re-recording through a filter with a response the opposite to that of the microphone-reflector combination. I tried this and an improved result is obtained, the bird sounding more natural. However, the difficulty is that any low-frequency unwanted background noise is greatly increased and unless an original recording with very low background can be obtained, the method is not very practical. Another difficulty is that the response varies greatly if the source is off axis and hence the filter used can only be correct if the sound source was accurately on the axis. Any other sounds off axis would, of course, be distorted due to the correction filter.

It is difficult to know just how much distortion is acceptable and again this depends on the application. If the recording is of a rare bird, then a recording with some frequency distortion is presumably better than nothing or one with large background noise due to the use of an open microphone.

An alternative to the microphone and reflector, and used by broadcast authorities, is the gun microphone. This has a more uniform frequency response if designed correctly. It does not have a sharp polar diagram, although the polar diagram does not change much with frequency. The microphone does not have the inherent gain of a reflector and is very expensive.

In practice, the polar response of any directional microphone will be changed by the reflection from local objects, from the ground and by the effect of any wind.

(Reprinted from Wireless World, by arrangement.)

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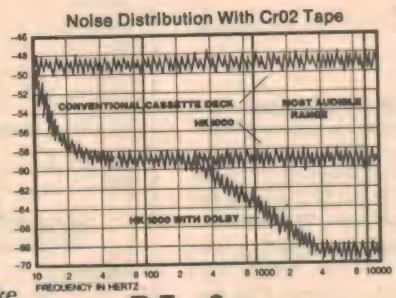
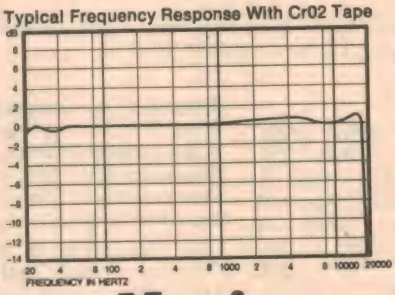



## Noise.




## Music.

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The HK-1000 is also designed so you can use it often without endangering it. Plug-in printed circuit boards are used for simplicity and reliability of operation. Heads are easy to reach and clean. And the transport is the most reliable we've ever tested; it even closes with the sort of reassuring "thunk" you normally hear only by closing the doors of expensive hand-built cars.

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# Novel design for protected supplies

Here is an interesting power supply regulator circuit which has been developed from a design published overseas. Although it uses only a handful of components, its performance is quite impressive. Details of a number of versions are given, to suit various applications.

by IAN POGSON

An interesting circuit for a Simple Current-Limited Stabiliser appeared in Wireless World for June, 1973, under the authorship of A. E. T. Nye. The circuit attracted my attention in that it looked to be a good starting point for further development. To describe the operation of the circuit by Mr Nye, I can do no better than to quote him verbatum. This is what he says:

"This simple circuit fits in the gap between the simplest emitter follower stabiliser and the more expensive series stabilisers with current limit protection.

"Emitter followers with zener diode stabilised input voltage are often used to provide simple stabilisation and ripple reduction on transistor equipment power supplies. A simple modification can be made to provide a current-limit action, using the circuit as shown in Fig. 1. Diode D2 is added to the complementary transistor emitter follower and at low currents does not affect the circuit other than to provide some temperature compensation for Vbe changes in TR1.

"The maximum TR1 collector current is approximately equal to Vz / R giving a maximum TR2 collector current of Imax is approximately equal to (beta. Vz / R), where beta is the DC current gain of TR2. If the load impedance becomes too low diode D2 becomes reverse biased and the current is limited to Imax.

"No component values are given as the circuit will work with a wide range of components to suit the particular application. Transistor TR2 should preferably be a silicon transistor, both from the point of view of heat sink requirements and of improved current-limit characteristic."

It may be gathered from the foregoing that the circuit as it stands is a very useful one. However, it has a couple of features which perhaps could be improved. The basic circuit is a complementary compound pair, and in this case TR2 is a PNP type. This may not be a disadvantage for low power applications, but it could pose problems at higher power levels. It is not easy to get a high voltage PNP silicon transistor also rated for high current. In order to get out of this one, the circuit could be revised to reverse the transistor polarity types.

The second point is that because the circuit merely limits load current, TR2 must dissipate a high power level in the overload situation. This drawback can be obviated, however, by adding a third transistor TR3 as shown in Fig. 2. Under normal operating conditions TR3 is fully conducting or "bottomed", and the circuit functions in substantially the same way as the original. But when the overload threshold is reached, TR3 cuts off and causes both TR1 and TR2 to cease conduction also. All three transistors thus dissipate virtually no power in the overload mode.

In the revised circuit, under normal load conditions TR1 carries the base current for TR2, while its collector to emitter voltage is approximately the difference between the input supply voltage and the zener voltage. The collector to emitter voltage of TR2 is about the same as that for TR1 but the collector current of TR2 is equal to the load current. Thus the power dissipation of both TR1 and TR2 can be readily assessed.

Under these conditions, TR3 is saturated and so the collector to emitter voltage is very low; but the current is again equal to

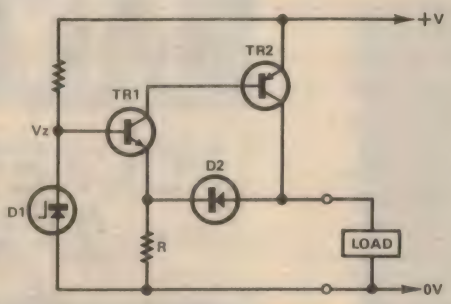


FIG. 1

the base current of TR2. Under overload conditions, the full input supply voltage appears across TR2 so that it must be suitably rated. Similarly when TR3 cuts off the voltage across it is approximately the zener voltage, so that a type must be chosen to withstand this voltage.

So far, we have not mentioned the purpose of the capacitor across TR3. Basically, this is to shunt TR3 and allow the circuit to commence operating when power is first applied. Without the capacitor the circuit would not start; when the supply voltage was first applied, it would lock itself out. Base bias would be available at TR1, but before it could conduct, TR3 would have to be conducting. It in turn could not conduct until it obtained base current via TR2 and D2, which would not be conducting!

When the supply is applied to the circuit, the charging current of the electrolytic capacitor provides an initial base current for TR1 and whole circuit becomes operative. The value of this capacitor will influence the behaviour of the circuit under certain conditions and more will be said about this later on.

It may be seen that there are two 0.1uF capacitors in the circuit which appear to have no influence on the normal operation. When developing the circuit and testing it under varying conditions, we found the capacitors necessary to ensure stability in all likely situations.

So much for the basics. Perhaps a design example or two may be of interest. Still referring to Fig. 2, let us assume that we need a regulated supply of 10 volts at a maximum current of 100mA. We must therefore start off with a rectified and filtered DC supply delivering at least 12 volts, at the load current of 100mA plus the quiescent current of the circuit.

A nominal 9V zener diode is needed for D1 and a low power one will be sufficient, The Philips type BZX79-C9V1 is rated at 400mW and the zener voltage is quoted for a current of 5mA. Added to this, we will allow a nominal 1mA for TR1 base current.

We may now calculate the value of the zener dropping resistor. With a 12 volt minimum supply, the voltage drop will be 3 volts at 6mA. This gives us a resistor value of 500 ohms, say 560 ohms in the 5pc preferred range.

In choosing a transistor for TR2, the prime consideration will tend to be power dissipation. In this sort of circuit the peak power dissipation for TR2 will tend to occur at a current level somewhat below the maximum of 100mA, as the unregulated input voltage will rise as the current falls. Thus while there may be only 2 volts across the transistor at 100mA, corresponding to a dissipation of 200mW, the input voltage may rise to say 14V at 80mA, increasing the power dissipation to 4 x 80 or 320mW. Just where the peak dissipation will occur will depend upon the exact regulation curve of the basic rectifier and filter.

It is probably reasonable to assume that in this particular case the peak will not subject the transistor to more than about 350mW at worst, however. With this in mind, one could probably use a TO-5 transistor with a nominal 400mW rating, such as the TT3638, etc, although a more conservative choice would be an 800mW type such as the TT800.

A second consideration when choosing the transistor for TR2 is the collector-emitter voltage rating. The maximum voltage applied to the transistor will be in the overload mode, when the regulator cuts off. Here the voltage is unlikely to rise much above about 18V, however, so that almost any transistor would be OK — certainly those just mentioned.

To determine the value of TR3's emitter

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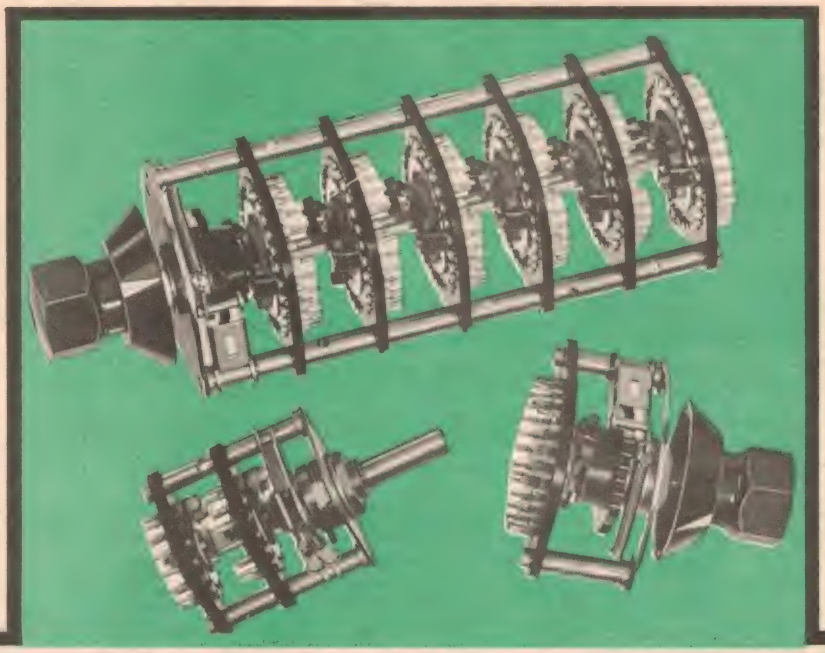

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## Protected supplies

resistor, we refer back to the formulae given at the beginning of this article. The maximum collector current of TR2 is 100mA and assuming the use of a TT800 which has a minimum beta of 40,

$$R = \text{beta}. Vz / I$$
$$= 40 \times 9 / 0.1$$
$$= 3600 \text{ ohms}$$

More than likely, TR2 beta will be above the minimum of 40 but it would be reasonable to fit a 3.9k resistor as a preliminary.

The type of transistor for TR1 is determined in this case by its collector current of a little over 2mA at the most, and the maximum voltage across it — likely to be about 9 volts. This is very modest and a BC108 or similar would be adequate. TR3 also has to pass the same collector current, but it must be able to withstand approximately the zener voltage under overload conditions. Here again there is only 9 volts involved and again a BC108 or similar would do the job nicely. Any ordinary silicon diode will do for D2, such as a BY126, EM401, etc.

The value of the electrolytic capacitor across TR3 may be determined experimentally. About 2uF is a good place to start. This should be sufficient for starting under no load, or light load conditions. If starting is sluggish under the wanted conditions, then the value of the capacitor should be increased to 4, 6, or even 8uF. There is no point in increasing the value beyond that which makes for satisfactory starting, as large values may tend to slow down turn-off when an overload occurs.

No doubt you have been wondering why we chose a nominal 9.1V zener diode when we decided on an output voltage of 10 volts. If we look at the circuit, it may be seen that we start with 9.1 volts at the base of TR1 and there will be about 0.6 volt drop to the emitter of TR1, making it about 8.5 volts. There is likely to be a small voltage rise between collector and base of TR3 and there will also be a further voltage rise of about 0.6 volt across D2. The net result is that the voltage across the output will be slightly higher than that at the base of TR1. The exact final voltage is not accurately predictable due to spreads in component characteristics. If necessary, an adjustment may be made at the base of TR1.

Assuming that the unit has been built, it may be switched on without a load. All being well, connect a voltmeter across the output and add a load in the form of a 100 ohm 2W resistor. The voltage should scarcely change under these conditions. Now remove the 100 ohm resistor and apply a 47 ohm resistor across the load. The voltmeter should fall to zero.

The above test shows that the unit will deliver the maximum design current of 100mA but when the load is doubled, the protection circuit functions. However, if you wish to make sure just where roll-off occurs this may be determined by substituting progressively lower values of resistor, below 100 ohms, until roll-off occurs.

Perhaps you may be satisfied with this as it stands. On the other hand, if you wish to change the current level where roll-off occurs, the 3.9k resistor should be reduced to increase the current or increased in value to reduce the current.

The next aspect of this circuit which we will consider is the use of a complementary set of transistors. The foregoing circuit will be quite satisfactory in most cases where a relatively low level of voltage and current are required — within the ratings of readily available transistors. However if we are looking towards a larger power supply, we will find it worthwhile to "invert" the circuit by replacing the PNP transistor with an equivalent NPN, and the NPN transistors with equivalent PNP types.

The resulting circuit is shown in Fig. 3. The values of components and the setting up procedure are the same as for Fig. 2. Transistors TR1 and TR3 are type BC177,

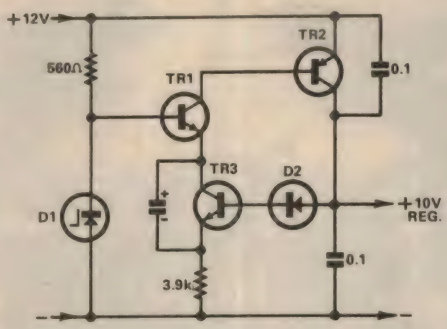


FIG. 2

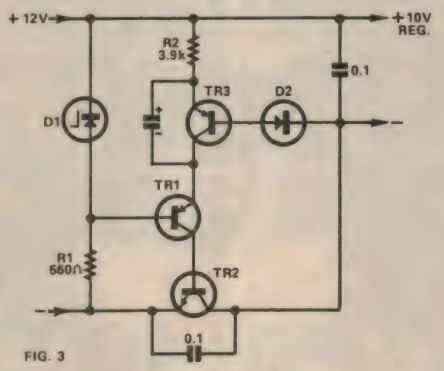


FIG. 3

BC178 or similar, while a TT801 is substituted for the TT800.

Suppose now that we wish to make up a power supply using this principle but at a rather higher lvel. As an example, we will choose an output of 30 volts at a maximum current of 1 amp before roll-off. For the purpose of this exercise, we will make use of the configuration Fig. 3.

It is obvious that we must have a rectified and filtered supply of DC at a value in excess of the wanted output of 30 volts. We will assume that a supply of 35 volts minimum is available. A type BZX70-C30 or similar 30V zener will be approrpiate. Should spread be such that the final voltage is too high for exacting requirements, then the zener voltage at the base of TR1 can be modified to suit.

The value of R1 as before is determined by the voltage drop required and the zener current recommended by the manufacturers of 2mA, plus 1mA for TR1. This makes R1 1.66k, say 1.8k.

For transistor TR2, the requirements are the ability to withstand the unloaded input supply voltage — say 40V — together with an Ic of 1 amp and a maximum power dissipation of between 5 and 10 watts. There are a number of NPN transistors which would meet this specification but we suggest the husky, relatively low priced and easy to get 2N3055, mounted on an adequate heat sink.

The value of R2 is calculated as previously, this time considering a collector current of 1 amp and a minimum beta of 20 for TR2. This gives a tentative value of 600 ohms. The power dissipation is calculated from a voltage of 30 and a current of 50mA, which is 1.5 watts. A resistor rated at 3W would be satisfactory.

The requirements for TR1 are an Ic of 50mA, a Vce of about 10V maximum and a power dissipation of about 500mW. TR3 has the same Ic of 50mA but has 30V applied between collector and emitter. However as it is either saturated or non-conducting, power dissipation is not important. Suggested types for both positions would be the BC177 or TT801.

As with the first design example, this one must have R2 determined after it has been brought into operation. The same method may be used to determine the current roll off, and R2 selected to give the correct maximum current before roll off. The capacitor across TR3 may be determined in value as discussed previously. However, it must be remembered that when overload occurs, approximately 30V will appear across this capacitor and so it must be rated accordingly.

We have actually tried the two design examples outlined and it is rather fascinating to watch the circuit behaviour under overload or short circuit conditions. Without any fuss, the circuit opens up and no power is dissipated in the load or the controlling transistors.

With success up to this point, we decided on a more ambitious supply which would be in keeping with those used for high power

## Protected supplies

stereo amplifier systems — 60 volts regulated at 2 amps. This is a considerable step above the 30V 1A circuit just outlined and while the principles are still the same, the higher voltages present problems in the selection of suitable transistors. There are transistors available but the choice is seriously narrowed and the price can become somewhat of an embarrassment.

Fortunately, we have been able to make a selection of transistors which will do the job and are a reasonable price. While availability may be not as good as some more popular types, no difficulty should be experienced in obtaining them.

The circuit of a complete power supply is shown in Fig. 4. No attempt has been made to give mechanical details for this supply, as it is intended mainly as a design exercise. Construction is only likely to be attempted by more experienced builders, and layout is not critical anyway.

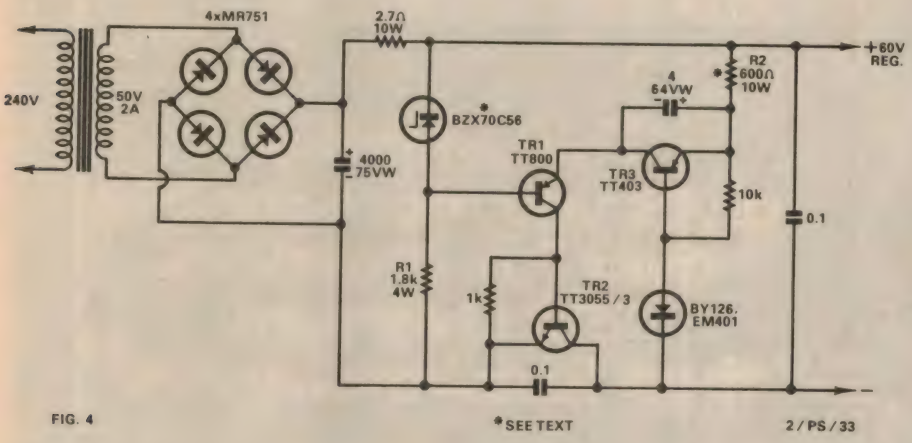


FIG. 4 *SEE TEXT 2/PS/33

It may be noted that the ratings of this supply are the same as those for the power supply used on the Playmaster 132 Stereo Amplifier, published in June, July and August, 1971. We have not had an opportunity to try this supply on the prototype of the Playmaster 132 but its substitution is an interesting possibility.

The design procedure for this circuit is the same as given in earlier examples, the only differences being with relation to the higher voltages, currents and power levels involved.

The transformer is the same as that used on the Playmaster 132 Stereo Amplifier. This transformer, together with the rectifier and filter give a DC supply of 70 volts, which is perhaps a little more than necessary for our application but it does allow for mains voltage fluctuations.

Initially, we tried a zener diode rated at a nominal 56V. In operation, we found that this particular diode gave us an output very close to 60V. As a result, we were lucky enough not to have to make any adjustments. Should the voltage fall lower than that required, then an additional zener diode may be added to the existing one, or if the extra voltage required is small, it may be possible to use one or more ordinary silicon diodes in series, using their forward voltage drop.

For TR1, we used the TT800 and this does the job satisfactorily. Depending upon the beta of TR2 and so the current which TR1 has to pass, it may be necessary to add a heat sink to TR1. In any case, this would be a wise precaution.

The demands made on TR2 are quite stringent. It must be able to dissipate a maximum of a little over 20 watts and this means that it must be fitted to an adequate heat sink. Under overload conditions, the collector-to-emitter voltage will rise to that of the full supply, which will be about 70 volts. The transistor which we have found to stand up to these conditions is the ITT type TT3055 / 3. This is of the same family as the 2N3055 but instead of the LVceo rating of 60V it is rated at 100V. Do not try to use the standard 2N3055 because it will more than likely let you down.

The value of R2, calculated on the basis of a minimum beta of 20 for TR2 and a maximum output current of 2 amps, is 600 ohms at say 10W. However, this is subject to considerable modification and must be selected to suit the beta of TR2. In our prototype, we finished up with a value of about 1.9k and this could reasonably be replaced with a standard 1.8k, on the assumption that making the current roll-off somewhat over 2 amps has no disadvantages for the particular application.

The requirements for TR3 are also rather demanding, particularly under overload conditions. Under normal conditions, TR3 will be saturated, but it must be able to carry the full base current of TR2. Under overload conditions, TR3 will be cut off and will have a collector-to-emitter voltage approximately equal to the zener voltage, 60 volts in this case. Another TT800 may just do the job but it is not good design policy to run right on the voltage rating. The type we suggest for TR3 is the ITT TT403, with a higher rating.

As you will see on the circuit, we fitted a 4uF 64VW electrolytic capacitor between collector and emitter of TR3. As explained earlier, this is for starting purposes. We kept the value down to one which ensured reliable starting even under full load. However, once overload has occurred, the circuit will not restart when the overload has been removed. It is necessary to switch off the whole unit and wait for a short time for the capacitor to discharge.

So there it is. We think that the idea is an interesting one, and the foregoing information should allow further work and investigation by those of you who may feel that way inclined.


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## An up-to-the-minute article on

# CMOS

# the tolerant logic

by LINDEN HARRISON

While CMOS logic devices are finding more applications every day, there are many engineers who still have not become familiar with CMOS technology. Briefly, CMOS has advantages over other logic circuitry of high noise immunity, reliability and very low power consumption. This article forms a good introduction to the subject.

"CMOS," short for "Complementary Metal-Oxide Semiconductor," was originated by RCA some 11 years ago, its action being based on that of the P and N MOS complementary pair. In digital applications this technology offers many features which outrun other logic families, however it has been only during the last 18 months that industry as a whole has begun to accept it. This being due mainly to rapid price reductions and the steady increase in the number of CMOS sources. Until that time almost all CMOS technology was developed for the aerospace industry, and was very expensive. A typical package a few years ago could cost anything between $16 and $160! Nonetheless, with a first class track-record for proven reliability and extremely low power-consumption, which has featured in satellites and military systems alike, CMOS has now moved on to score even greater successes in brand new markets.

Control systems in noisy industrial environments, desk-top computers, automotive products like seat-belt circuits and ignition systems, in telecommunications and in portable consumer goods like calculators as well as solid-state watches, these are all major areas where CMOS in its various forms and functions will be gobbled up in the very near future.

Unlike other forms of MOS, CMOS is available in a whole range of MSI products, just like bipolar logic's '9300' DTL, and '7400' TTL series, and the range is being added to steadily. Additionally, there are also many LSI products being introduced, Solidev for example recently announced their CM4102, which is a 3½ digit display device ideally suited to DPM applications. Whilst in the UK, specialist manufacturers like Emihus Microcomponents offer a complete custom design and manufacturing service with the aid of Computer Aided Design into such areas as hybrid and linear CMOS. In the USA, companies such as Ragen Semi-conductor have been in the sophisticated custom business for several years working on mostly military projects. Amongst their product range appear such devices as their MS618, a CMOS 96 bit variable length 'elastic' shift-register, and linear-digital comparators integrated on to the same chip. In Italy SGS-ATES adding both ion implant and silicon gate processes to their present technology to achieve very low voltage operation.

RCA, the undisputed leaders in CMOS from whom much of today's technology has stemmed, introduced their CD 4000 family several years ago. But being the only source at the time proved a handicap, and many designers and purchasing departments were too sceptical to change over to the new technology despite its obvious advantages, and chose to play safe and stuck with more established technologies. Now, however, there are many other CMOS manufacturers who are not only second-sourcing many of RCA's standard product range, but who are also creating new and interesting products too. Main contenders in the second-source market of RCA's CD4000A range are Motorola's MC14000, Solidev's CM4000A, Solid State Scientific's SCL4000A series and SGS-ATES HBF 4000A series which are all pin-for-pin equivalents. Higher speed equivalents are available at higher cost from manufacturers such as Harris Semiconductor, Hughes Micro-electronics, and Inselek Inc.

Certainly standard TTL will be with us for a long while yet, but already CMOS has gained a lot of new followers from many previous users of standard P-MOS and low-power TTL, in applications where high speed (ie 10MHz) has not been necessary. Already one major TTL manufacturer, National Semiconductor, is producing an equivalent range to 7400L series in the form of pin-for-pin compatible CMOS, where many of the same familiar functions are now available in this new logic family. National term this series simply 7400C (C for CMOS) and plan to add more functions each month during the remainder of this year to the many products already available. National are also second-sourcing on CD4000A series, as well as developing certain key LSI products.

Standard CD4000A series CMOS is the result of a process known as "Metal-Gate" technology, and is designed to operate over a very wide voltage range of between three and 18 volts. This is excellent for the majority of industrial applications, where the 5pc voltage tolerance previously imposed by TTL's nominal 5 volt rail can be overcome. CMOS works from a single voltage rail as does TTL, but unlike the latter it will work reliably from an unregulated and poorly filtered supply, and with a noise immunity typically 45pc of the supply voltage! The inevitable power supply capable of providing several amps for TTL would be wasted in any CMOS system, because a typical gate working at 1MHz and 5 volts supply will consume less than 1mW!

Thus, whilst TTL itself has been very inexpensive, hidden factors such as well-regulated transistorised power supplies, heat-sinks and double-sided printed circuit boards have added costs to the basic TTL system. Those who believe that TTL is still cheaper in fact, should appreciate that with a CMOS system the user effects a total system cost reduction. No heat needs to be dissipated, no bulky and powerful transformers are necessary, neither is there any need for a regulated power supply or r-f bypass capacitors. Indeed, because the chip packing density with CMOS technology is many times greater than with TTL, this leads to increased circuit integration and results in a physically smaller system size. Whereas previously several packages were necessary with TTL, with CMOS in many instances only one single device would be required. As for the manufacturer, the product is much easier to manufacture because production tolerances can be much less critical, and CMOS is well suited to automatic handling techniques.

CMOS makers, however, feel that even lower voltages are possible to run their products from, and as a result new markets and opportunities will emerge, such as the digital wristwatch market. Thus many of the companies already in the market place are able to offer MSI and LSI products which will reliably operate at only 1 volt. Even this level has not deterred some manufacturers such as RCA, SSSI, Emihus and Motorola from developing circuits capable of operating at an incredible 0.7 volts! However, this type of CMOS is relatively new and confined mainly to special products such as watch circuitry. It is known as "low-threshhold" or "silicon-gate" CMOS, and is somewhat more difficult to manufacture than normal metal-gate. Fairchild Semi-conductor are believed to be perfecting an easier method of producing silicongate CMOS, prior to joining the other big names in this field, with CMOS products of their own.

Another technology which can be applied to both forms of CMOS is "dielectric-isolation," a somewhat more advanced process still, and still in its early stages. However, the prime advantage with this process is that speed can be increased to a level directly comparable with standard TTL, yet power consumption and low voltage operation are both maintained at the normal very low levels associated with CMOS. (One drawback with standard CMOS is that of a speed limitation above approximately 10MHz.) Harris Semiconductor second-source CD4000A series with their own HD4000 series, and claim that by using dielectric-isolation a typical propagation delay of only 10 nanoseconds is obtained. This type of speed, unobtainable

(This article reprinted from "Electron" magazine, by arrangement.)

until recently with CMOS, is as fast as TTL, and could therefore create something of a worry to TTL manufacturers, whose main counter argument to CMOS has been based on that of speed.

The basic building element common to CMOS i.c.s is the P and N "inverter-pair," operated in series but across the power supply (see Fig 1). The P transistor is situated next to the +ve supply and can be considered as being "upstairs," whilst the N transistor is situated "downstairs," next to the —ve rail. The individual transistor gates are tied together, so forming a single gate. (The Nor and Nand functions (see Fig 2 and Fig 3), as well as clocked logics, are formed by series and parallel combinations of this basic inverter-pair).

The key to the ultra-low power consumption and the very sharp switching characteristic, which in most instances makes CMOS superior to all other types of logic, and thereby comes closest to the "ideal," is due to the fact that both transistors join in the switching action. If one considers the inverter-pair circuit, it is easy to see this inverter operation, for when a positive voltage V is applied to the input, the P channel device turns off and the N channel device is switched on, thereby making the output Vss, via the equivalent on-resistance of the N channel transistor. Alternatively, by connecting Vss to the input will switch the N transistor off, and switch the P device on, thus connecting the output to Vdd through the on-resistance of this transistor. The exceptionally high input-impedance of the inverter-pair, typically 100M is created by reversed-biased junction leakage in the input protection networks, whilst the relatively low output-impedance, typically 1K , is due to series channel resistance in the conducting transistor. All these factors ensure that the output will swing hard all the way up to the positive supply, or down all the way to the negative supply.

Whereas TTL gates consume power during both the on and off states, the very low power characteristic of CMOS is attributed to the fact that apart from when actually switching, only one transistor is on at a time. The majority of the power dissipation is due to the charging of circuit capacitances, not, as one could easily believe, from the resistive flow through the partially on transistors.

The second basic building element is the "transmission switch," Fig 4, which is unique to CMOS, because it acts as a single-pole single-throw switch capable of passing analog as well as digital signals, in either direction. Physically the only difference between the transmission switch and the inverter-pair is in the basic metal interconnection pattern. The transistors in this configuration are arranged to be in parallel, the sources and drains of the P and N transistors are tied together and powered by the signal, so that the pair is either switched on or off together. The advantage of this parallel arrangement is that neither signal swing will be limited by the gate-threshholds and the signal can swing right across the whole supply range from Vss to Vdd. Thus a sine wave may be readily switched; but its value must lie within this range.

The off-resistance of this element is

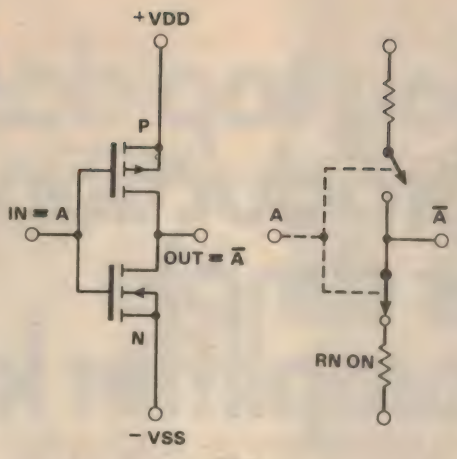
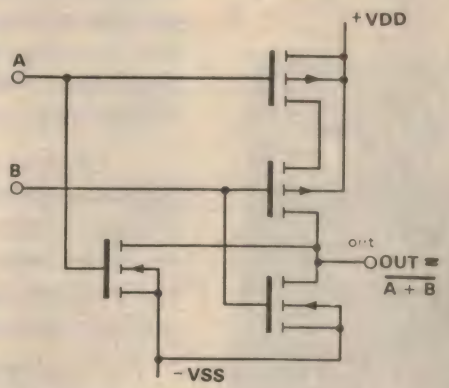



FIG. 1

*CMOS inverter pair and equivalent*




*CMOS NOR gate*

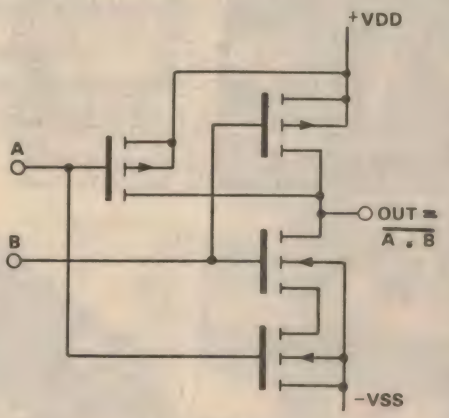



FIG. 3

*CMOS NAND gate*

essentially an open-circuit (ie 100M ), whilst the on-resistance is of the order of a few hundred ohms only. These characteristics closely approach those of an "ideal" switch, and as the sources and drains of these devices are interchangeable it does not matter which way round the signal passes. A built-in inverter-pair is usually provided, so as to act as the control element of the transmission switch. When used in digital systems, two or more such switches can be used to select which of several signals is to be routed to a particular gate. Siliconix, who are very strong in the field of CMOS analog switches and multiplexers, manufacture a whole range of switch elements from the basic type up to a 16 channel device. This is called a DG 506, and consists of a 16 channel multiplex driver-switch. It incorporates a 4-line binary decoder (with enable) and drivers for each channel.

An example of how the transmission switch is used within the CD4000A family flip-flops is given in Fig 5, where the clock controls two transmission switches on and off in opposition. When the clock goes high (logic 1) transmission switch A is closed to let data flow into the flip-slop's Nor gates, which is possible because transmission switch B is open, and the Nor gates are unlatched. When the clock goes low (logic 0), transmission switch A opens, cutting off the data input path, and transmission switch B closes to hold the data latched in the Nors. An identical slave flip-flop working on the opposite phase of the clock will usually follow this.

In many designs it is necessary to use a mixture of logic families, and in this aspect CMOS interfaces readily and without problems with any other logic family, and even with devices such as LEDs. However, one factor which should be borne in mind when using CMOS is that it has a limited fan-in capability, due to the fact that a complete PN pair is needed for each input. However, in some instances it is possible when operating CMOS at upper voltage levels to add a few extra inputs with diodes, as with DTL, although manufacturers do not recommend this, claiming that the input-threshold level shifts, and the noise immunity characteristic is degraded. Solid State Scientific Inc (SSSI) offer a solution to the problem in the form of their SCL4402, expandable Nor gate, and SCL4412 expandable Nand gate, as some of the terminals on the final inverter-pair are left uncommitted, thereby enabling the user to expand inputs as necessary so as to create for example an 8-input Nand gate.

CMOS fan-out on the other hand is limited only by the effect of wiring capacitance on output speed, and thus fan-outs of greater than 50 are quite realistic. It is also possible to drive the more efficient types of LEDs directly from the outputs of certain CMOS buffers / drivers, if a few volts can be allowed across the driving transistors, but the o power-dissipation limit of the total package must not be exceeded. For example, with a 5 volt supply, seven output stages each driving an LED at 5mA will dissipate a total of only 116mW, well within the capabilities of many CMOS devices.

CMOS, whilst interfacing with itself, also interfaces directly with DTL and TTL actually improving the overall noise immunity of the bipolar logic. It operates, of course, from the same single supply rail, unlike other forms of MOS that require high negative voltages. However, standard CMOS is not yet as fast as TTL, and not all CMOS devices can meet the typical 1.6mA at 0.5V current sinking requirement when operated from a 5V supply. One easy way round this is to parallel devices to obtain greater current output, alternatively buffers such as the CD4009A or CD4041A can be used. The TTL-DTL to CMOS interface requires that a pull-up resistor be always used, and in systems where CMOS is operating at a higher supply than the preceding logic, it is recommended that an open-collector device such as an SN7407 be used.

Interfacing with PMOS is also easy for CMOS. In positive logic systems the CMOS needs only to be connected between compatible supply voltages, as long as Vdd—Vss is 15V or less. If CMOS is used with

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negative logic PMOS, it is necessary to use open drain (uncommitted drain) transistors as available in devices such as the CD 4007A or SCL4412, also negative logic rules apply, thus a Nor function becomes Nand and vice versa.

In most instances, CMOS is preferable to PMOS because it does not require multiphase clocking, nor does it require high negative voltage supplies. It is faster than PMOS, and coupled with the factor of ultra-low power dissipation and ease of application, it holds several distinct advantages. However, whilst CMOS is directly suited to MSI products, PMOS is suited to LSI, especially the memory market, where it has a distinct advantage in terms of being an easier technology to use, and in device size and complexity. But CMOS has some way to go yet and it is likely that it will be able to equal these requirements before much longer, and overtake PMOS.

CMOS is claimed by most users to be the easiest logic family to use once one has become familiar with it, simply because it works first time and needs no excessive debugging. It is ideally suited to proto-type breadboarding, the high noise immunity being a major advantage here, so that long cables can be used to connect up without the normal worry of signal-attenuation. Altogether CMOS, because it's so simple to use, saves the design engineer a lot of headaches and ulcers! But there are still some basic considerations to be met to ensure smooth operation.

One practical problem that often puzzles engineers when they first start using CMOS is that concerning gates that have inputs left floating. Unlike TTL, where unused inputs are often left floating, this is not so for CMOS. If an input is left unconnected, the chances are that static charges will be picked up, which will cause the gate to shift erratically from one logic state to another. This will result in the CMOS spending much of the time in the linear biased-on region of the transfer curve, and will result in increased power dissipation and reduced noise immunity. Thus with CMOS all unused inputs must always be tied to either supply rail, or alternatively paralleled with other like inputs.

Another precaution is not to allow an input signal whose +ve and —ve excursions exceeds the CMOS + Vdd and —Vss, to put more than 10mA into an input. This applies especially to oscillator and capacitively coupled circuits and it is recommended that a high value limiting resistor of say 1M is connected in series with the input.

CMOS products a few years ago used to be susceptible to static charges, because the inputs are ideal storage points for high voltage static build-ups. The result would be that the high voltages would destroy the device. For example, walking across a domestic carpet or waxed floor can generate static in the kilovolt range, and this coupled with body capacitance when discharged into a CMOS input would cause the gate oxides on the chip to fail! Nowadays, however, manufacturers protect their inputs very well with diode-resistor combinations, and these prevent such damage from happening. Inputs should not be overloaded even though they are protected, and reference should be made to the manufacturer's data sheet.

Even so, outputs are not protected by such networks and it is preferable to use grounded soldering-irons in assembly (Litesold make an exceptionally good transient-free adjustable temperature iron), and test equipment should be grounded. For the same reasons it is recommended that CMOS devices should be packed for transit in conductive foam, and not in plastic containers on which static may build up.

Slow rise and fall times as well as too low or too high clock speeds will cause CMOS to spend excessive time in the linear region, causing false clocking and normal power dissipation to be increased. It is advisable to keep rise and fall times to less than 5us, and where a certain speed is required over the full temperature range, a derating factor of 0.3 per cent per degree Celsius of the dynamic characteristics should be applied.

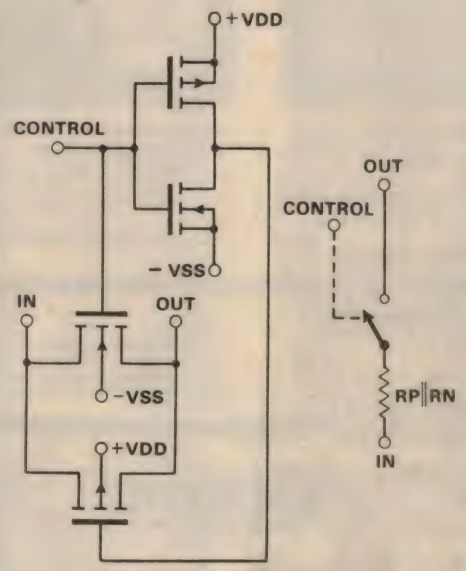


FIG. 4

*Above is a CMOS transmission switch and equivalent and below is a CMOS flip-flop controlled by transmission switches.*

It is not advisable that CMOS should drive relays or incandescent lamps, due to the large amount of current drawn. The result will be that the maximum package dissipation of 200-300mW will be exceeded and the device will be destroyed. Other than that gate outputs are almost foolproof because of the element of on-resistance that is introduced by the conducting transistor. This acts as a current-limit and will protect the outputs if accidentally shorted to either supply rail. So that at 5V all the outputs of a device may be simultaneously shorted without exceeding the maximum dissipation rating. At higher voltage levels this may not be possible as it could exceed the maximum rating.

All in all, experience with the product and careful design will enable the engineer to take full advantage of what CMOS has to offer.

Although new products are being introduced all the time, there still exists a certain gap in available CMOS products when one compares the full range of TTL. To this end RCA have devoted much attention, realising that although their CD4000A series covers the broad spectrum, it may still not be yet enough. As a result of this study RCA are developing at least 20 more different products, which are hoped to close this gap and which will gradually become available in the near future. Some of these will be a BCD-7 segment-Latch-Decoder / Driver, a 200-bit Dynamic Shift-Register, a 256-bit RAM, a 4-bit Comparator, and many more. In the meantime, some interesting new additions to RCA's product line have been an LSI 4-bit Arithmetic Array (CD4057A), a Phase-locked Loop (CD4046A), a Multi-function gate (CD4048A), as well as a Monostable-Multivibrator (CD4047A), to mention just a few. RCA having a vested interest in liquid-crystal readouts, another technology they pioneered, has also recently introduced three CMOS driver units specifically for liquid crystal products.

Presently RCA does all the diffusion and fabrication in the US, whilst assembly is carried out in the Far East. Well ahead in

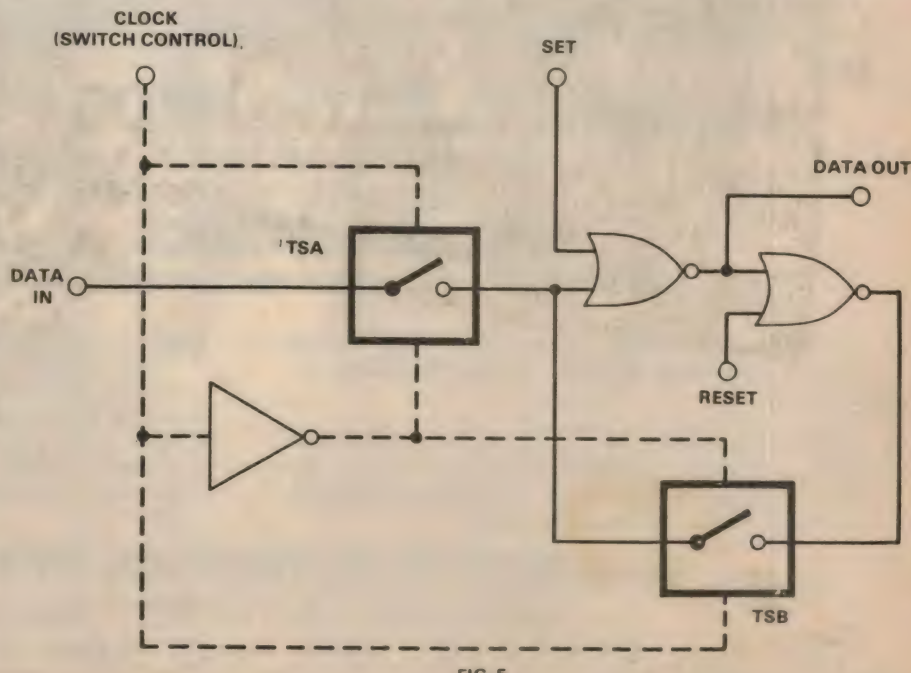


FIG. 5

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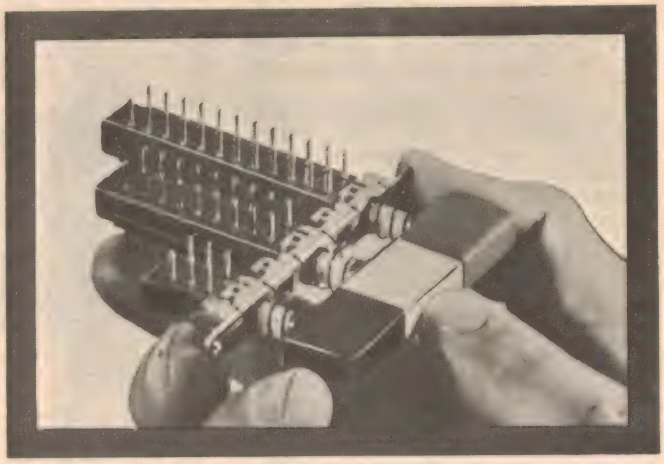

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development in New Jersey are silicon-gate devices and even some silicon-on-sapphire prototypes have been manufactured on a custom design basis. RCA are still out ahead of the field, but there are many other manufacturers not far behind.

Motorola, who are hard on the heels of RCA, have invested heavily into CMOS striving to capture some of that lead which RCA with ten years experience have gleaned. Presently all Motorola CMOS (McMOS) wafer product is diffused at a brand new facility in Phoenix, Arizona, whilst assembly is completed in Korea. Motorola have decided to strengthen their share of the European market by setting up production at their large new plant in Scotland. Right now production equipment is being installed, and it is likely that by early autumn CMOS production will commence. Motorola are also interested in the custom-design business and as such have a central European design centre in Geneva.

Two major areas in which Motorola are heavily committed are the watch and automotive markets. The watch market where they are already selling a kit comprixing a micro-motor, quartz oscillator, and count-down circuitry, is reckoned to be worth millions of dollars. The first watch on the market using the Motorola kit is made by a leading Swiss watch manufacturer, Girard Perregaux. The other enormous market Motorola foresee is in automotive products, where the proposed US legislation later this year could possibly put the number of required products beyond any manufacturer's capability!

However, during the course of this year Motorola plans to introduce around 30 new standard CMOS products, many of which belonging to their MC14500 series, whilst others will second-source RCA's CD4000A series. One newcomer, MCM14524, is a 1024-bit ROM, which amazingly derives its memory array power from the clockline by charging internal capacitances on the chip. Another memory product MCM14537, which will be available shortly, is a 256 by 1 RAM. By late summer a 3½ digit DVM chip will be available, and by year's-end such devices as a touch-tone encoder, a five decade counter, and a variable length 64-bit shift register will be available. Clearly Motorola are catching RCA up fast!

Another major contender is SSSI, a CMOS specialist company, who recently gained a massive automotive contract with a leading manufacturer. One large customer is NASA's Marshall Space Flight Centre, who have decided to use CMOS memory and logic in the High Energy Astronomy Observatory scientific satellite, which is due for launch in 1975. Something like 16,000 CMOS devices will be used on Mission A, and include 23 different logic functions as well as two different memories. It is estimated that the contract which is spaced out over some long period of time could total several million dollars.

SSSI are also understood to be supplying-gate CMOS watch circuits for Optel Corporation's liquid-crystal displays, which are specially made for major Swiss manufacturers. A great deal of technology is pouring out of SSSI in the form of easy-to-use products like expandable gates, etc, and it is likely that this company will become one of the largest suppliers of standard CMOS. In the UK, Impectron Ltd are the representatives for SSSI.

Solidev, the UK division of Solitron Devices Inc, are also fast adding to their standard product range whilst also being busy in the custom CMOS business supplying watch and calculator circuits. Some of these products were seen publicly for the first time at the IEEE recently in New York. Recent additions and new products imminent include a 3½ digit counter, a 4-decade BCD Decoder for liquid-crystal displays, as well as a 1024-bit RAM, and many more. At present no CMOS is manufactured in England, and is all made in San Diego, California. Solidev, who are already one of the largest sources in the world for power devices, are also likely to be one of the foremost sources for CMOS. Products are available from Solidev's UK representatives, Distronic Ltd at Harlow.

Other companies who are known to be putting a lot of work in on CMOS include North American Microelectronics who are reported to be developing ultra-high-speed silicon-on-sapphire devices, which should be available by the end of this year. Signetics is another contender, and reckon to have products available by the end of the summer in the form of some elementary gates and also some memories.

Texas Instruments are also reputed to be working on CMOS in Dallas, and unofficial sources claim that TI should be ready to introduce first commercial products before the year's end. It is feasible to suggest that as TI is already supplying liquid-crystal readouts to certain major watch manufacturers, that they also have the capability already to produce CMOS watch-circuits. However, for TI the decisions relating to becoming a major supplier of CMOS are very much more difficult, as many of the markets that CMOS is aiming at are already covered by TTL.

This could equally well apply to Fairchild, who are known to be working on CMOS at Mountain View. As yet no product details have been announced, but because Fairchild are pioneers of silicon gate technology for standard MOS, they could easily have the edge on other manufacturers if they applied this experience to silicon-gate CMOS.

Another major semiconductor manufacturer expert in standard MOS is American Microsystems who are currently supplying CMOS circuits to watch manufacturers. As yet, this market is the only CMOS market that AMI is involved with, claiming that they have their hands full with standard MOS for now.

Intersil Inc are also large CMOS watch circuit manufacturers, currently supplying Omega and also Seiko in Japan. Apart from their interests in this market, they are presently concentrating their efforts into the analog-gate and memory business. A range of analog gates and multiplexers is being introduced in May, and by August several memories are planned, one of which is a 256-bit RAM (IM6523), a pin-for-pin replacement for the bipolar version (IM5523). Intersil are represented in the UK by Tranchant Electronics Ltd.

Siliconix who have been in the CMOS business for some while now are already established in the LSI business in the US, and can now offer a total custom design-manufacture facility. This is aided by the medium of video tape recording so that the interchange of highly technical information between the parent company and the facility in Swansea is performed most efficiently. As such, Siliconix are able to custom build complex CMOS circuitry to a better advantage than the great majority of US manufacturers. At present CMOS fabrication and diffusion is performed in the US, whilst assembly and testing is done in the UK at Siliconix's Swansea facility, this plant handling most of the needs for Europe. Standard products to date include an entire range of analog gates, switches and multiplexers, and the capability exists for special products such as DVM chips where bipolar technology has been adapted for the analog portions, and PMOS and CMOS have been used for the digital and switching applications.

A small UK company, U.C. & G. Ltd, recently caused quite a stir in the industry with the announcement that they were planning on producing CMOS products aimed at the pocket calculator and automotive markets. Although U.C. & G. have assembly and R&D facilities, they do not plan on gearing up for wafer processing, preferring to contract out to specialist manufacturers. Meanwhile, following the introduction of their first calculator ic, HX2005C, a simple 8-digit 4-function machine which draws only 2mA, and which can drive an LED display direct, U.C. & G. have produced another CMOS product in the form of a sequential logic unit, designed for security applications. Production has already started on this product, and U.C. & G. are able to supply initial quantities already. The unit takes two forms, the simpler is claimed to have 5000 numerical combinations, and is directly suitable as an anti-theft system for a car, whereby the ignition cannot be started until the individual combination is keyed in.

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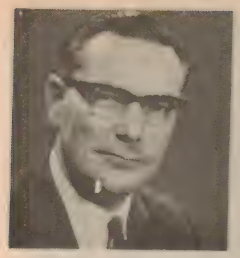

# FORUM

Conducted by Neville Williams

## *Colour television: truth and fiction.*

If a prize were to be awarded for technical murk in newspaper articles, a recent effort by "Square Eye" in the Sydney Sunday Telegraph would surely have a strong chance of winning. The article certainly promoted any amount of incredulous comment amongst my industry associates.

Not surprisingly, it also caused quite a few non-technical acquaintances to inquire about the possiblity of obtaining one of the magical devices mentioned in the article. Nor was the speculation limited to Sydney, as the following letter will indicate:

*Dear Sir,*

*May I draw your attention to an article in the Sunday Telegraph of August 5, which says that about one thousand Australian households are watching colour television on sets which are normally black and white, with a device known as a "chromalock", and which costs about $100 to make.*

*Is this fact or fancy? I would very much like to hear your comments on the article.*

*R.B. (Nhulunbuy, NT)*

Well, this I must say, that a tabulation of the remarks heard about "Square Eye" would have made interesting reading containing, as they did, a good deal of speculation about Square Eye's family tree and state of mind.

But, technically, it would be more relevant merely to quote paragraphs from the article in question and make appropriate comment.

QUOTE: "About 1000 Australian households are watching colour television on sets which are normally black and white with the help of a device which costs about $100 to make".

COMMENT: It could easily be inferred from this that the receivers involved are normal black and white sets, which are being made to display colour. Forget it. To see colour, the viewer must have a complete colour receiver to begin with. The $100 gadget is additional to whatever the colour set might cost. There is no way worth bothering about of converting a black and white set to display colour.

QUOTE: "The device, known as a chromalock, is a small box of transistors and complex electronic circuitry which reconverts colour signals sent out by television stations in black and white so that the original colour appears on the screen."

COMMENT: Neither the chromalock nor any other conceivable device could do this. Once a colour scene or a colour film has been reduced to monochrome by a camera or cine chain, or once the colour information has been suppressed by any other means, it cannot be recreated or restored. Even a full-scale colour receiver can do no more than reproduce a black and white transmission in black and white.

QUOTE: "By law, television stations must scramble the colour signals until the official introduction of colour television in 1975."

COMMENT: The Australian Broadcasting Control Board is actively discouraging the few stations that have colour camera chains from radiating live colour signals. Occasionally a film will be transmitted in colour, but most of the colour signals which get to air in Australia come from overseas videotapes of colour programs. The colour signals do not have to be scrambled. All that the station is required to do is to eliminate the burst reference signal which is essentially synchronising information. What the chromalock does is to synthesise a reference signal to which a normal colour receiver can lock.

QUOTE: "A friendly electronics expert told Square Eye this week that only dedicated electronics enthusiasts are using the chromalock at present and the industry wants to keep it a secret."

COMMENT: Only dedicated enthusiasts are using the chromalock at present because only dedicated enthusiasts have been able to buy or build the necessary colour receiver and to build and install the chromalock! The industry has no guilty secret, as one might infer. But it certainly would not want to promote to the public expensive television sets, equipped with expensive chromalock units, for the sake of watching a few programs which happen to include colour information.

QUOTE: "The chromalock will never be available to the general public. Enthusiasts will only use it until colour television is introduced officially. Then they will switch to colour sets."

COMMENT: Again the implication seems to be that the enthusiasts are using black and white sets, plus chromalock. The fact is that they are using colour sets already, otherwise they could not display the colour. When stations are allowed to transmit the colour synchronising burst, the enthusiasts will simply throw away the chromalock.

QUOTE: "We do not want to make it known to the general public because the conditions have to be just right for the chromalock to work".

COMMENT: This statement is right and it is strong reason, as I said earlier, why it would be foolish to promote expensive colour receivers and chromalocks to the public — even if the Broadcasting Control Board raised no objection. No less to the point, "right conditions" mean a lot more than just the receiving situation. Colour transmissions are more an accident of circumstances than deliberate at the moment; they are not subject to quality control and colour aberrations are commonplace. Enthusiasts understand this and allow for it; the public would not.

QUOTE: "People with chromalocks attached to their sets are now able to watch scores of programs in colour."

COMMENT: Members of "Electronics Australia" staff have been keeping a watch on the Sydney scene in recent weeks with a colour receiver. On many nights there is no colour at all, on some a single half-hour. Two programs on the same night is really something and Wednesday is a riot with three scheduled. Whether or not you would want to watch the particular programs is another matter. You could see scores of programs, only if you watch for scores of weeks!

QUOTE: "The expert, who has the device fitted to his own TV set describes the colour he sees as superb".

COMMENT: Some segments are superb but others are just the reverse. TV station operators point out that their program material is supplied and paid for on the basis of monochrome transmission. It may contain colour information but they can have no complaint if the colour happens to be degraded. Even good colour may be degraded locally if it has to run the gauntlet of equipment still in use, which falls short of colour standards. Fed with such signals, the chromalock may in turn fail to do its job properly. It's amazing how un-superb a blue face looks!

QUOTE: "He is able to watch the ABC news in colour since it switched over on July 1."

COMMENT: The ABC did radiate shots of the news reader in colour for a couple of weeks but, allegedly at the prompting of the Control Board, they had filtered out the colour from the Sydney transmitter before Square Eye's article appeared. In any case, the film clips, &c were all in monochrome so that, at best, the ABC news was a frustrating mix of a gaily adorned news reader commenting on black and white scenes. It would have been better the other way round.

QUOTE: "I suspect that the chromalock business is a matter of the industry jealously guarding its own interests."

COMMENT: That suspicion is patently obvious and it has conjured up a dark plot out of the efforts of a few engineers, enthusiasts and servicemen to get a bit of preliminary experience with what colour is available.

For their own technical purposes the effort might be justified but I can assure you — as would other members of our staff — that the entertainment value of the presently available colour is strictly limited. There's little pleasure in seeing in colour, programs that you would not regularly watch. There's also acute frustration in having a colour set which

remains stubbornly black and white on programs that you really want to see in colour!

So the public is really being deprived of the opportunity of wasting large sums of money on nothing in particular.

It's just a pity that Square Eye didn't manage to do a better job with square facts.

Now for a change in subject:

For quite a few years there have been skirmishes in the columns of this journal about the use and meaning of the terms Hertz and "cycles per second", and about the second itself. An article on the subject by Len Spackman, published in December 1968, was challenged in our March 1973 issue and it is only fair to grant the aforesaid contributor the right of reply. Hopefully, the matter will rest there.

The challenge in the March issue was touched off by a writer from Queanbeyan, NSW, who said that much argument and confusion existed at his particular establishment because of the seeming contradiction between Len Spackman's article and an Australian Metrication Board publication.

Asked for a comment, a spokesman for the Board referred the matter to an officer of the CSIRO involved in maintaining time standards within the Commonwealth. By implication, he queried whether the fine distinction drawn by Len Spackman had ever existed or, at least, had ever enjoyed international recognition.

Here is Len Spackman's reply:

*Dear Sir,*

*I refer to "Forum" by Neville Williams, March 1973 page 57, under the title: "Gentlemen, Please choose your seconds".*

*As a result of a controversy about the relationship of cycles per second and Hertz I wrote an article for "Break In" which was published July 1968. You paid me the compliment of reprinting this article in your December 1968 issue. I do not have a copy of this.*

*At the end of Mr Williams' article in the March issue he poses the question: "Did Len Spackman research events more thoroughly or did he over interpret their significance"?. The answer in each case is no.*

*I have been interested in precise frequency measurement for some 20 years and, during this time, I have co-operated with overseas and New Zealand authorities in experiments with VLF propagation and comparison of frequency differences between various standard frequency transmissions as received in New Zealand. The facts, as I stated them, are well known to all of those who are active in this field.*

*If your naval correspondent had asked a navigation officer in the Royal Australian Navy he would have received the information he desired. It is explained quite fully in various issues of the Nautical Almanac. The Explanatory Supplement to the Nautical Almanac, 1961, HMSO, London discusses the various time scales extensively and should be consulted.*

*My original article in "Break In" included some ten references and I am wondering if you omitted them from your reprint. Apart from reference (1) which referred to a previous issue of "Break In" all the authors quoted were the leading authorities in the world at the time and the publications are the leading scientific journals on the subject including the Transactions of the Royal Society.*

*All of the articles mentioned will be in the library of the CSIRO, Sydney. They explain matters much better than I could.*

*For the benefit of those who may be further interested may I recommend the following additional references: The books, "Spherical Astronomy," Woolard & Clemence, Academic Press 1966 and "Spherical and Practical Astronomy as applied to Geodesy," NY, Ungar 1969 are stated to be excellent but they are not in my library. For a highly mathematical explanation of the relationship between the various time scales refer to Markowitz, "Astronomical & Atomic Time," USNO 1959.*

*Finally, could I mention something which all your correspondents have overlooked. At the beginning of 1972 a new time scale was adopted throughout the world. This time scale is based on Atomic Time and not on Mean Solar Time.*

*Co-ordinated Universal Time (UTC) which is the same as GMT and is civil time is now based on International Atomic Time. Mean Solar Time (UT1 and UT2) are no ionger used for civil time but are still used for navigational purposes. At zero hour, UTC, January 1st 1972, UTC time was retarded 0.1076 second to make it precisely 10.000 seconds late with respect to International Time. Relativity with UT1 is now maintained by periodic adjustment of precisely one second so that UTC time does not vary by more than 0.7 second from UT1. One second adjustments have been made June 1972 and January 1973 so that UTC is now 12 seconds slow with respect to Atomic Time.*

*Because of the above alteration in the basis of UTC there is now no difference between cycles per second and Hertz. They are exactly the same. This should make everybody happy.*

*L. S. Spackman ZL1AC*

On reading the above letter, my first reaction was to assume that we had not published the list of references and that this had put the critics at a disadvantage. But, in fact, a check on the original issue revealed the references, so that the ball is back into the critics' court.

But the most important thing is that the parties agree that there is now no distinction between Hertz and cycles per second. So you can continue using whichever term you prefer without danger of being misunderstood.

I can just hear all those sighs of relief!

Just to round things off, I would like to acknowledge a letter from a reader, M.S. who lives at Canvey Island, Essex, England. He is in an area which is on the very fringe of a UHF colour television service and says that loss of colour is a hazard in these circumstances. He attributes his problems to a change in polarisation of the transmitted signal, as supported by the fact that rotating the aerial away from the horizontal often helps in such conditions.

It would seem that the adverse propagation conditions are causing differential phase shift in the colour information, resulting in desaturation. It raises the question as to whether similar effects would be apparent with VHF televion after all!


## *On customer attitudes*

**It has been said that the worst aspect of servicing is the customers. While this generalisation might be a slur on the large majority of reasonable customers, it is true that a small percentage can be quite hard to get on with. My first story is a typical example.**

It is a double barrelled story, in that it concerns two calls to the same customer. The calls were not really related, and I include the first one mainly for its humour. At the same time, it does help to describe the customer and her way of thinking.

The customer was a dear old lady who lived alone on the third floor of a block of home units. Although my first impression was of a mild mannered personality which had retained many of the desirable attitudes of a bygone age, I was to discover, to my cost, that this same dear old lady could be quite outspoken — in fact almost caustic — when she felt she had a point to make.

It is also important to mention that she had an "insurance" contract on her TV set. The firm concerned pays me a flat labour rate, plus the price of the parts, for each call. Sometimes I get a sticky one that is not nearly covered by the labour fee but, overall, I make out all right.

The first call involved a faulty picture tube. This involved obtaining a replacement and making a second call to fit it. When I arrived with the tube the dear old lady bustled about, removed assorted ornaments and bric-a-brac from the top of the TV cabinet, together with a quite decorative table lamp.

It turned out to be a perfectly straightforward job. Everything went smoothly, and I even managed to get the tube exactly square in the harness the first time. Finally, with the set running, I went over the various controls and adjusted height, width, linearity etc and satisfied myself that all was well.

As I moved the set back where it belonged, I enquired whether I should leave it running.

"Oh — no thank you, I don't think there is anything on that I want to see today. Switch it off."

As I did so I also enquired whether I could help her replace the various ornaments. Again she politely refused.

"I'd better dust them first," she explained.

So I took my leave.

I had just seated myself in the truck and was about to drive off when a very breathless dear old lady burst out of the building entrance.

"Wait, wait, the TV set's blown up."

My first reaction was one of puzzlement. While I didn't know what she meant by "blown up," I reckoned that, whatever it was, it was the first time it had happened while a set was switched off. I must confess, though, that by the time I had trudged up three flights of stairs again, and had time to think about it, I wasn't feeling so cocky. Was it the picture tube? Had I tightened the harness too tight? Had I fitted a tube with a strain in it?

It was quite a relief when she opened the door and I detected a faint smell of burning rubber. Whatever it was, it wasn't the tube. In fact, it was nothing to do with the TV set at all, but turned out to be the table lamp.

A quick check of the innards showed why. The cable was the old rubber covered variety, and the heat from the lamp had cooked the rubber into a hard brittle mass. It was all right while it stayed in the one place but my recent calls had been too much for it. The last straw had been when the dear old lady moved it back onto the TV cabinet. The rubber had disintegrated into a mass of hard pellets, the wires had twisted and, when she switched it on — phut! In fact, from what she told me, it must have put on quite a display.

At my suggestion, I took it with me. It was the kind of job I could tackle in an odd moment, and drop back when I was in the district again.

The second call was several weeks later. This time it was "no sound, no picture." I quickly diagnosed a defunct 5AS4 rectifier and fitted a new one. The picture came up bright and clear and I prepared to depart.

"Oh — before you go," said the dear old lady, "there's something else. The set's been wobbling a lot lately."

I suppose, had I taken her statement literally, I would have checked the cabinet legs, but I assumed she meant the picture. The term "wobbling," like her expression "blown up," was one which could mean almost anything. I questioned her as diplomatically as I could, but achieved very little. To be truthful, I sensed that she resented my questions. In these circumstances I could only point out that there was no sign of the trouble now and that I couldn't do much about it until it appeared.

I offered to take the set back to the shop, but she was adamant that she did not want this.

"In that case," I said, "we can only wait until it shows up again. Hopefully, it will appear more frequently, or continuously, and I will be able to track it down."

Even then I sensed that she was not convinced, but there was little more that I could do.

As usually happens, I forgot all about the problem almost as soon as I started on the next job. Then, a couple of weeks later, the dear old lady was on the phone, and I quickly sensed that she was pretty irate.

"This wobbling is nearly driving me mad. It's ruining my eyes. If you can't fix it I'll call the insurance company and make them send someone who can." She paused for breath.

I very nearly said, "Go ahead. Whoever they send is welcome." But I didn't. It would be just my luck for the "someone else" to walk in while the fault was in full swing, fix it in three minutes flat, and earn himself a reputation at my expense.

"I'll be over first thing this morning," I said, trying to sound as calm as possible.

I need hardly say that when I arrived the set was working perfectly. Once again I tried to get a better description of the effect, but with little success. And once again I tried to explain that it was impossible to fix a fault which didn't exist. Which brought forth a reply which I reckon takes first prize for cockeyed reasoning.

"You're an experienced serviceman. You must have seen this fault before. You ought to be able to fix it!"

Words failed me. With reasoning like that, what point was there in trying to explain that I had seen at least half a dozen faults which would fit her vague description? And even if I had formed some kind of an opinion about the most likely one — which I had — there could be any number of possible causes. And that there was no way of nominating which of them it was.

To placate the old soul I decided to wait a reasonable time in the hope that the fault would show. I removed the back of the set, partly to have immediate access in case it showed, and partly in the hope that a spot of chassis pounding might bring it on. As far as this latter point was concerned I might just as well have saved my energy; nothing I could do had any effect.

After about half an hour I felt I could wait no longer. I started to gather up my things and prepared to replace the back of the cabinet. At which point the dear old lady suddenly exclaimed, "There it is. It's doing it now."

One glance at the screen was enough. It was, as I had half suspected, a "hula girl" effect, and a bad one. It would almost certainly be due to hum in the line timebase, though by what precise mechanism this was happening I had yet to discover.

I lost no time in going over the chassis with the butt end of a screw-driver, gently tapping all likely components. Nothing definite showed up, but the sync separator valve seemed to be a little touchy. I plugged in a new valve and the trouble vanished. I replaced the old one and it returned. That was it. I assume it was an internal short such that hum from the heater was finding its way to one of the other elements.

And so the episode eventually ended happily. But the real point of the story is the extent to which customers can get themselves steamed up over situations of this kind. They seem quite incapable of appreciating the difficulty of dealing with intermittent faults or of accepting the serviceman's word that this is so.

Rather ironically, these people are usually the ones who fall victim to the slick

talking characters who take little account of the truth of the situation, but present a plausible story based on what the customer wants to be told. Usually, the more outlandish the story (technically) the more likely it is to be believed; the closer it is to the truth, the more it is suspected.

I still don't know whether this dear old lady eventually realised that I had been telling the truth, in spite of subsequent events. Or whether I have lost her as a customer.

Only time will tell.

Changing the subject, here are are a few comments — or perhaps "whinges" would be a better word — concerning some of the things manufacturers do which rebound in the field. Some of these are the result of my own observations; some are from colleagues.

One concerns a locally made portable TV set; outwardly a nicely designed unit housed in a high impact plastic case. The unit in question was brought to me because, after only a modest bump, the picture had failed completely. There was also an ominous rattling from inside.

When I removed the back, the reason for the failure was painfully apparent; the neck of the picture tube had been broken off. The reason for this was also clear; the case design was so tight that the base of the picture tube was jammed hard against the back of the cabinet. And I mean hard: the imprint of the tube base had moulded itself into the plastic. For all the good the back was, it might just as well not have been there.

As far as I was concerned this was an isolated case, though I did wonder how many others might have suffered a similar fate. I wasn't left wondering long. I ordered a new tube and in due course the carrier delivered it. As he pushed the carton onto my workshop rack he noticed the set on the bench, with the broken tube still in place. His comment — and he was only the carrier mark you — was, "Aw no! Not another one!"

"Why?" I enquired.

"Aw heck, you just oughter see the number of tubes that get broken in that set."

Which is doubtless pretty good business for the picture tube manufacturer, but a scathing indictment of whoever designed, and approved, the cabinet.

The only good point about the situation is that, as I understand it, the model was withdrawn after a fairly short run. As far as the maker's reputation is concerned, it would have been better if it had been withdrawn before there was any run at all.

Another point, more in the nature of a suggestion this time, was raised by a colleague. It concerns the problem of mounting a new picture tube in its harness and ensuring that it is mounted exactly horizontal on the long axis. Anyone who does this job regularly knows that, almost invariably, the first effort results in the tube face being slightly askew; tilted downwards to one side or the other. And it can take quite a bit of fiddling to get it just right.

My colleague suggests that the tube manufacturers might be able to provide a standard reference mark somewhere on the rim of the tube. This could be transferred to the harness, using, say, a felt pen, before the old tube was removed. When fitting the new tube, one would simply line up the tube reference mark with the one on the harness.

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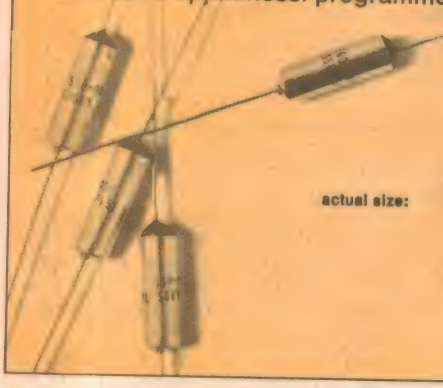

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AC92

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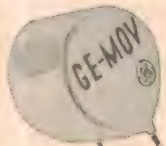


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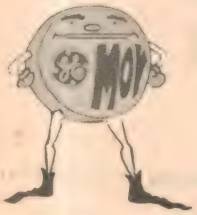


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Another whinge concerns the use of screwed connections, typically involving self-tapping screws, for leads that have to connect to chassis. These are a prolific source of obscure and intermittent troubles, particularly where quite heavy currents are involved, as in filament circuits.

No doubt it is cheaper than other techniques, including soldering, but the kind of fault it can create, which is often very costly to find, does not endear it to either the customer or the serviceman, both of whom usually finish up out of pocket

In fairness I must say that one manufacturer who previously did this seems to have abandoned the technique, probably because others complained as I have done. But they weren't the only ones and if any manufacturers are still using this method they would be well advised to reconsider it.

The next point may seem a trivial one; in fact I'm sure it will to the manufacturers. One manufacturer recently elected to change his pilot and dial lamps from the popular miniature Edison screw base to a bayonet base.

Yes, as I said, it sounds trivial. But think of the serviceman in the field who encounters this for the first time. Very often a customer will make as much fuss over a faulty pilot light as they will over an off-centre voice coil of a picture only half as high as it should be. So the serviceman fishes out a replacement and reaches for the faulty lamp, only to find that he has nothing to replace it. I can assure you there is nothing trivial about the return visit he has to make, just to replace a few cents worth of lamp!

Granted, after being caught the first time, one can be prepared. But this means that one must now carry two types of lamp instead of one. It is just one more thing to worry about when ensuring that adequate stocks of all likely replacements are always on hand. It is bad enough having to cope with all the variations in valves and other component types which various manufacturers normally specify, but at least there is usually some good reason for these selections.

But dial lamps! Surely the industry could reach an agreement on such a simple component.

The next point is, again, more in the form of a suggestion, and results from some quite lengthy discussions with various colleagues. It should be prefaced by saying that we generally agree that the section of TV sets which causes the greatest number of service calls is the vertical deflection system.

In fact, the vertical system appears to be the least protected part of most circuits, in that it is normally sensitive to line voltage, temperature, valve ageing, resistor ageing, etc, with little or no compensating circuitry to cope with these changes.

Be that as it may, and without seeking to argue the merits of whatever compromises the manufacturers find expedient, the fact remains that a very large number of service calls are caused by the need for periodical readjustment of the vertical controls. In fact, the most common of these vertical faults is invariably described by the customer as ". . . a black band appearing at the top and bottom of the picture."

And, in the great majority of cases, correction requires nothing more than a quick touch up of the height pot. Granted, one usually checks the linearity adjustment as a matter of course but, by and large, the amount required is so small that the simple height adjustment would have been adequate.

In fact, whenever this situation is encountered, some kind of a decision has to be made. The purist would argue that, since it is obvious that one or more components have become degraded, the correct thing to do is go right over the vertical circuit and replace every out of tolerance component. In theory, I agree. In practice, one has to consider the economic situation. The time required for such an overhaul would make it quite costly. Can this cost be justified if one can substitute a simple adjustment, involving a minimum service charge, and which has minimal effect on linearity?

My personal policy is to offer the customer the choice. It is easy to demonstrate the effect of simply adjusting the height pot, after which I point out that, strictly speaking, that section of the set should be overhauled. But I also point out that they will probably get another 12 month's use out of the set, perhaps more, by simply adjusting the height pot. I even show them how to do it themselves.

I need hardly add that almost invariably they settle for the simple adjustment, reasoning that it will be time for a major overhaul when they run out of adjustment, or the picture becomes so distorted (non-linear) as to be intolerable.

Granted, this approach may appear to cut across one's financial interests. Probably it does, on a short term basis. But the goodwill which such obviously genuine advice creates will more than offset this in the long run. Customers will feel that they can ask your advice and get an honest answer. In short, they will trust you. And a customer who finds a serviceman he feels he can trust considers himself lucky; he won't leave you.

In the light of all this it seems a pity that manufacturers no longer locate the height pots where the customer has ready access to them, or in anyway encourages the customer to use them. I say "no longer" because some of the early TV sets were so constructed. One in particular which I recall had several of the lesser-used controls, including height, located at the front of the set, behind a small hinged panel which normally hid them from sight. Unfortunately, this design did not last long.

I realise that manufacturers will probably protest that encouraging owners to fiddle with height and linearity controls will only result in them getting things into a heck of a mess. It might too, if they were encouraged to fiddle with both. But if they confine their activities to the height control, there is little that can go wrong. Which is why I confine my suggestions to this control, when advising customers. (When I do the job myself I naturally make whatever linearity adjustments appear to be necessary and possible.)

Significantly, the set I mentioned earlier, with the height control at the front (but the linearity at the rear), is one on which I cannot remember ever having to adjust the height pot. By the time the customer called me, there was no adjustment left.

So there we are Mr Manufacturer; a series of whinges and suggestions from people who are closer to your customers than anyone else, the servicemen. What about it?

# The flutters are for learners

Think back to when you were learning to drive a car. Remember when you applied incorrect tension to the clutch and kangaroo-hopped down the road? Well, the same kind of thing can happen to a tape-deck that doesn't have devices on the motor clutch to automatically maintain correct tension. That's what causes flutter—the strange vibration that distorts sound. However, one tape deck has discarded its L-Plates and learnt how to drive. **The AKAI 4000DS.** Once this beautiful deck starts ticking over, you can forget about clutch trouble and distorting flutter. Only AKAI—the tape specialists—have licked the problem. If you've thrown away your L-Plates when it comes to good music, then you should sit at the wheels of the AKAI 4000DS. We think you'll be driven to buy it.

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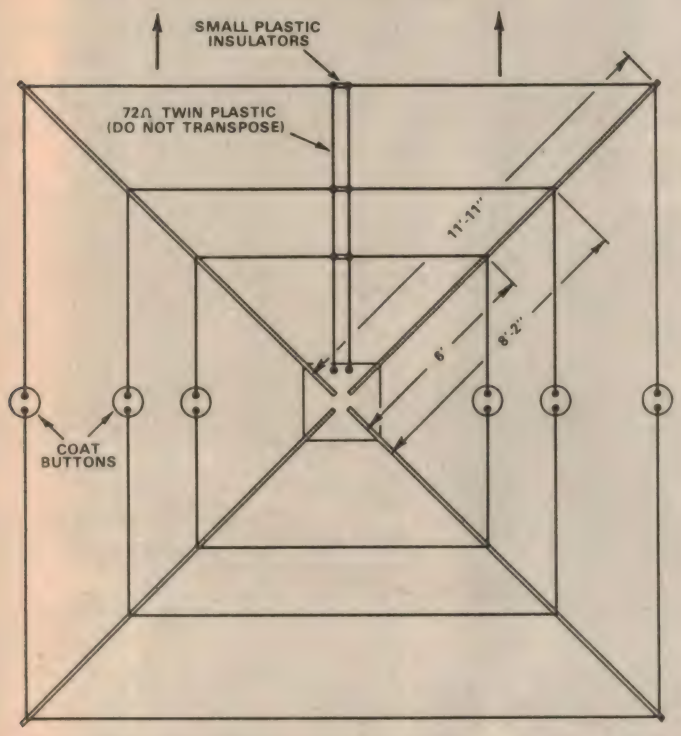
AK 39P

# CIRCUIT & DESIGN IDEAS

Interesting circuit ideas and design notes selected by the Editor from technical literature, reader contributions and staff jottings. As they have not necessarily been tested in our laboratory, responsibility cannot be accepted. Contributions to this section are always welcome.

## The VK2ABQ Triband Beam




Over many months, I have been working on an aerial system which has shown so much promise that I thought that others may be interested in my findings thus far. The first one was in the shape of a bow tie and it also resembled the now well known X beam. The bow tie configuation, while very successful as a single band array, did seem to present some difficulties when the idea of a tribander was to be considered. And so after a lot of experimenting I am now using what I consider to be the simplest and best home brew tribander yet. It has no traps or coils and so no losses related to such devices, also no mysterious blobs of electronics hanging on the array. Also, mechanically the system is very simple, it has no boom and a 14, 21 and 28MHz version has a turning radius of only 12 feet.

Many questions may be asked. Is it better than a quad? What is the forward gain? Frankly, I do not know. However, tests on the air indicate that it has a back-to-front ratio of 3 to 4 S units, with substantial gain over a dipole. On long haul contacts, the indications are that the angle of radiation is low. Comparisons, with the kind co-operation of Max, VK2BMH, indicate that his commercially made 3 element single band medium spaced Yagi on 14MHz is level pegging with me into such distant points as New York. We both run the same gear and the aerials are both at about the same height. This is about as fair a comparison as coluld be arranged.

Terry, VK2BTS, who lives close by, has also built one of these beams and is duplicating my findings.

The drawing shows the general arrangement. I used a piece of board 15in square in the centre and then two pieces of ¾in conduit 10ft long and mounted at right angles on the board. Then an 8ft length of ⅝in diameter dowel was inserted into each of the four ends of the conduit. Any metalwork used for the frame must be securely bonded to the mast. The three loops are then arranged as shown, making sure that the loops are a little longer than the final figure. Leave the loops uncut at this stage, except for the interconnecting feeder. I used 72 ohm twin feedline but 300 ohm ribbon should be satisfactory.

Adjustment is carried out with a GDO. Insert a one or two turn link across the interconnecting feeder at the board and check for resonance. When dipping, to make sure that the dip is of the loop of interest, grab the loop at a voltage point — where a button will be placed later on. Change in dip indicates that it is the correct dip. If not, grab the interconnecting feeder and a change in dip shows that it is due to the feeder. With adjustments carried out about 4ft above the ground, the loops should be trimmed to resonate at the low end of each band. When raised, the resonance points will shift to about the middle of each band.

Now cut each loop at exactly the mid point on each side. These points are insulated with coat buttons. Pass each lead through a hole in the button and tie a knot as close as possible to the wire end. This operation will use very little of the loop length and the resonance will stay the same as before. The aerial will now radiate bi-directionally, with good back-to-front ratio and forward gain. Loops are held in place by any temporary means and when adjusted, the loops are held by open ended screw eyes, screwed into the top of ecah rod.

The impedance appears to be about 50 ohms at the feed point where the line is attached to the centre board. A 50 ohm coax feeder may be used and it will be found to give a low SWR across each band. No balun has been found necessary and the radiation pattern is symmetrical.

(By Mr F. Caton, 1 Mills Street, West Merrylands, NSW 2160.)

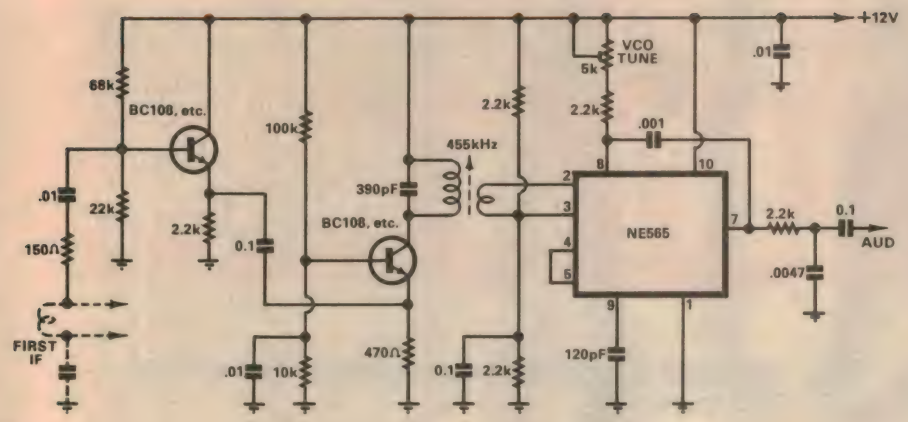
Editorial note: This appears to be a very interesting approach to the never ending search for the ideal aerial system. Of necessity, the description must be short but there should be sufficient information for readers to duplicate the original. Any further findings relating to this aerial would be welcome and may be published if considered to be worthwhile.

## An FM Detector for Amateurs

This relatively straightforward outboard FM strip using a low-cost phase-locked loop IC may be of interest to those radio amateurs who, like myself, have until now been operating mainly on the "tuneable" part of the VHF bands using AM. I have built it into my existing home-brew tuneable-IF receiver, and it gives very clean demodulation of the many relatively wide deviation FM signals found on the FM net channels.

Like others before me, my first attempts to provide the tuneable-IF receiver with an FM demodulation facility involved alternative detector circuits at the end of the existing 455kHz IF strip. But while this approach can give good results with narrow deviation FM signals, it is virtually useless for the wide-deviation signals produced by many of the converted FM-mobile transceivers in use on the VHF net channels. The reason is, of course, that these signals cannot pass through the relatively narrow 455kHz IF passband of the usual AM / SSB receiver.

The only real way around the problem is to add not just a separate detector, but a complete parallel IF channel with an adequately wide passband. If a conventional approach were used, this would become quite a job, but luckily modern semiconductor technology can again come to the rescue. In this case, it comes in the




form of the NE-565, a low cost phase-locked loop IC made by the Signetics Corporation. This lends itself very readily for use as an FM detector at up to about 500kHz, and has almost enough gain as well to operate directly from the mixer output.

It does need a little additional gain in order to cope with weaker signals, together with a modest amount of 455kHz preselection — mainly to stop the loop from jumping across to a stronger signal on an adjacent channel! The circuit shown seems to meet these requirements fairly well, and yet is quite straightforward. It takes the 455kHz signal from the low impedance secondary of the first IF transformer in my solid-state receiver, but has a fairly high input impedance and could probably be connected into the mixer plate circuit of a valve receiver without undue loading.

Alignment must be done on a week signal, as a strong signal will pull the PLL and give deceptively good results even when the circuit is badly misaligned. Basically the procedure is quite simple — use an aerial attenuator or the RF gain control of the receiver to progressively reduce the signal level, and adjust both the IF transformer and the VCO tuning pot to give clear demodulation for the smallest possible signal level.

The type NE-565 phase locked loop IC should be available locally, or it may be obtained direct from Tecnico Electronics, 53 Carrington Road, Marrickville, NSW.

(By Jamieson Rowe, "Electronics Australia.")

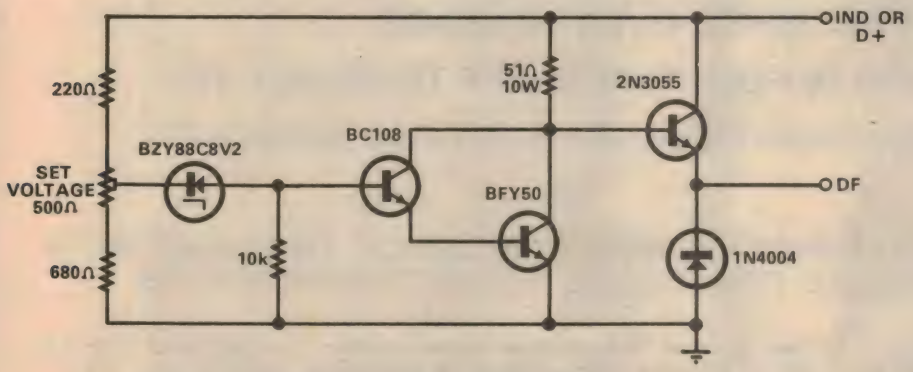
## Automotive Voltage Regulator

This voltage regulator was built to replace a faulty one of the single relay type as fitted to the HR Holden using a Bosch alternator. The new regulator has been in use for about seven months and during this time the preset potentiometer has not had to be touched. The voltage reading at 650rpm with headlights on is 13.8V and at maximum rpm with no load, it is 14.2V.

Regulation is fast and continuously variable, depending on load. Unlike the regulator it replaces or many electronic regulators, no suppression components are required, as the regulator uses a higher power field control transistor and it does not rely on switching to reduce dissipation.

Comparing it with the regulator described in Electronics Australia for January, 1972, figure 9 on page 43, I feel that the new circuit has some advantages to offer: (1) No thermistor is fitted as correction has been noted to be rapid and accurate under all conditions. (2) The voltage adjusting potentiometer is a readily available and cheaper item. The use of this preset potentiometer became possible by using a Darlington pair, thus reducing the current through the zener diode / potentiometer network. (3) Only 10 components are required, compared with 14.

(By Mr A. Kethel, Telephone Exchange, Thomas Street, Chatswood, NSW 2067.)



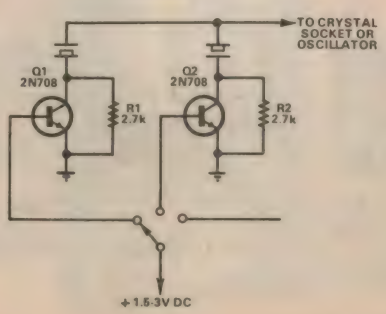

12V NEGATIVE CHASSIS REGULATOR

## Crystal Switching Circuit

Here is a crystal switching circuit for oscillators using grounded crystals. A 2N708 or similar high speed switching transistor may be used for Q1, Q2, and so on, while R1, R2, etc are 2.7k, ½ watt.

The crystal switching scheme is similar to the familiar diode scheme but is more positive without problems encountered with leaky diodes (output on more than one frequency). The desired frequency is selected by applying 1.5 to 3V DC at the point indicated.

(From "CQ".)



# Television — Modern Systems

## (Part 2)

Sound transmission. The TV channel. Receiver functions. The tuner. IF amplifiers. Video detector. Intercarrier sound. Sound IF. Video amplifier. Sync separator. Differentiation and integration. Vertical oscillator. Horizontal oscillator. Flywheel circuits. Vertical output circuit. Horizontal output circuit, EHT, boosted HT, AGC. Power supply.

In the previous chapter we discussed the basic principles of television, the manner in which a television signal is generated, and the final form it takes when ready for transmission. Briefly, this consists of a complex waveform comprising the video information on a line by line basis, interrupted at the end of each line by a line synchronising pulse, and at the end of each field by a block of field synchronising pulses. In this chapter we plan to discuss how the signal is received and processed by the receiver.

First, however, a brief mention of the sound (or audio) signal. Because sound transmission is something with which we are relatively familiar, there is a tendency to take it for granted in association with TV. In fact, it must be treated as a part of the overall system if good results are to be obtained.

Early TV systems — including the British 405 line system which is still in operation — used AM sound transmitted on an adjacent frequency. Later systems switched to FM sound, both to take an advantage of the superior noise rejection properties of this system and to simplify some aspects of sound and picture separation in the receiver.

Australian TV uses an FM sound system, with a deviation of plus and minus 50kHz, an audio response to 15kHz, and treble pre-emphasis amounting to approximately 13dB at 15kHz, relative to 1kHz. Treble pre-emphasis is a fairly standard procedure for FM program transmissions to provide as much protection as possible against noise. Complementary de-emphasis is provided in the receiver to produce a level response from the audio system. The sound transmitter is normally located higher in frequency than the picture — or video — transmitter and, in the Australian system, always exactly 5.5MHz away from it. The reason for this precise spacing will be evident later.

In greater detail, the distribution of signals within an Australian TV channel is as follows: The picture carrier is located at 1.25MHz above the lower limit of the 7MHz channel, the sound carrier is 5.5MHz above this, and the upper limit of the channel is .25MHz above this again. Vestigial sideband transmission is used for the picture carrier, which means that most of one set of sidebands (usually the lower) is suppressed. Australian practice is to suppress all but 1.25MHz of the lower sidebands adjacent to the carrier, and this is the reason for the picture carrier position 1.25MHz above the lower limit. Australian TV channel frequencies range from 45MHz at the lower limit of channel 0 to 222MHz for the upper limit of channel 11.

A brief comparison may be worthwhile here. Whereas one TV channel occupies 7MHz, the entire broadcast band occupies about 1MHz. And into this we can put 100 sound transmissions each nominally 10kHz wide. (In fact, by means of channel sharing, the band is currently accommodating over 200 transmitters.) Thus, on a straight channel for channel basis, the total TV signal occupies 700 times as much spectrum space as a sound transmitter!

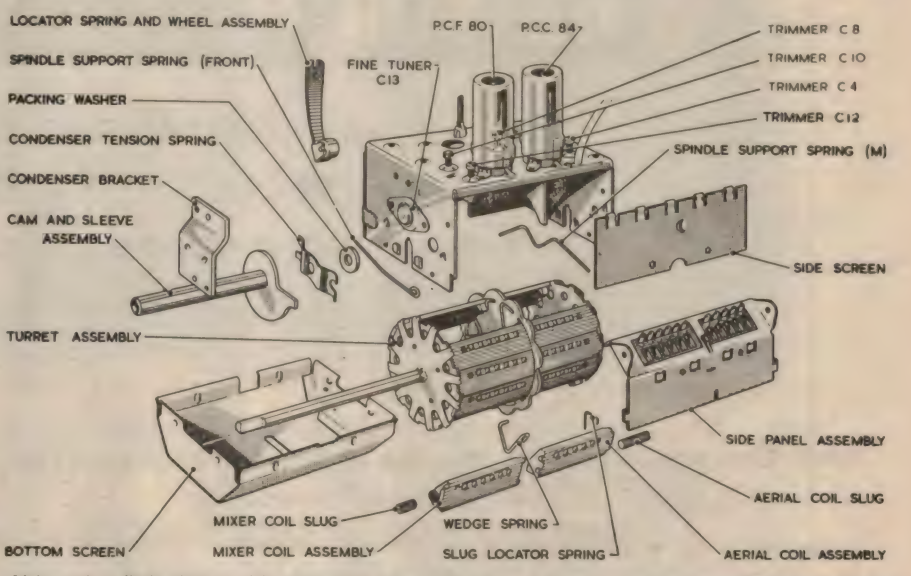
From all the foregoing it is quite obvious that the TV receiver has to handle a much more complex signal than a simple sound receiver. For one thing, it has to handle the 7MHz bandwidth of the transmitted signals, at the same time providing compensation for the vestigial sideband transmission and correct levels for sound and video signals to ensure minimum interference between them. And, having done that, it has to sort out the complex of signals which constitute the complete TV transmission. It has to separate the sound from the video, the video from the sync pulses, the horizontal pulses from the vertical pulses, and then process each according to its requirements.

A logical place to start is the tuner. Physically, this is a self-contained unit, which may be mounted either directly on the chassis, or separate from it, where the cabinet layout dictates such an arrangement. Heater and HT power are derived from the main chassis, as is AGC (**automatic gain control**) voltage. Signal from the tuner is fed to the chassis via coaxial cable.

Among other things, the tuner has to tune over a wide range of frequencies — approximately 45 to 220MHz to cover the 13 channels of the Australian system. Fairly obviously, such a requirement is beyond the scope of a simple variable capacitor tuning system as employed in a broadcast or short-wave receiver. Instead, a system of coil switching is employed with a set of coils being switched into circuit for each channel. A small variable capacitor is provided as a **fine tuning control**, to compensate for drift due to temperature, valve aging, etc.

There are two popular methods of selecting coils: (1) by means of more or less conventional rotary switch wafers, or (2) by means of a turret. In the switching system the switch contacts engage connections which are, in reality, tappings on what amounts to one continuous coil. For the highest frequency channel only a small portion of the coil would be in circuit while, for the lowest frequency channel, the whole coil would be employed. This arrangement is called an **incremental tuner.**

The alternative arrangement provides a set of completely self-contained coils for each channel. These are mounted on plastic bases equipped with suitable contacts and,




*Although a little dated, this exploded view of a turret tuner gives an excellent idea of the mechanical principle. Ease of coil adjustment or replacement is a major feature. Even where transistors are substituted for valves the same basic mechanism is used.*

# Keep a clean head


One of the many Maxell advantages is a unique new tape leader that keeps the heads of your sound equipment clean. So the sound stays clear.

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N1651/3

by reason of their shape and colour are popularly referred to as "biscuits." They are supported between discs mounted on a central shaft, in such a way that the contacts face outwards. As the central shaft is rotated, the coil assemblies rotate with it, each set making contact in turn with a set of fixed, wiping contacts. A mechanical indexing system on the central shaft ensures that each set of coils is moved into exactly the right position to correctly engage the contacts. Such an arrangement is known as a **turret tuner**.

Electrically, tuners consist normally of two stages, an RF amplifier and local oscillator / mixer. The RF amplifier is usually a twin triode in a **cascode** configuration, a very popular arrangement which provides a useful order of gain with low inherent background noise.

The mixer / oscillator stage usually employs a triode / pentode valve, with the triode in the oscillator circuit and the pentode functioning as the mixer. The tuner is designed to have a bandpass wide enough to encompass the full band-width of the TV channel — 7MHz — and the "Q" and coupling of the tuned circuits are selected with this in view. As with normal superheterodyne practice, the local oscillator runs at a higher frequency than the incoming signal and this transposes the relative positions of the video and sound carriers. Whereas the sound carrier is transmitted as the higher frequency it appears as the lower intermediate frequency.

The Australian system has used two intermediate frequency standards. The first specified 36MHz as the picture IF and 30.5MHz as the sound IF. More recently, alternative values of 36.75 and 31.25 have been adopted by some manufacturers in an effort to minimise spurious patterns which can occur in some circumstances. Note particularly that, regardless of the IF, the 5.5MHz difference between sound and picture is retained.

From the tuner, the signal goes to the IF channel. As well as amplifying the signal, the IF channel has the job of "shaping" the receiver's response to the various frequencies within the passband, an important function which can have a marked bearing on the quality of the picture and sound.

In short, the IF channel, like the tuner, must accommodate the full 7MHz bandwidth of the channel, but with the difference that it is not required to respond to all frequencies equally. To achieve adequate bandwidth several stages are employed — from two to four typically — with several tuned circuits. These latter may be loaded with resistors to reduce their "Q" and broaden their response, while the coupling between them is arranged also to produce the same effect. In addition, the various circuits are stagger-tuned, that is, tuned to different frequencies within the required passband.

It is usual to refer to the IF channel response characteristic as the **shape**. This is a convenient concept because the method of adjustment employs a **sweep generator** and a cathode ray oscilloscope, the latter portraying the response of the channel in graph form. Thus we tend to think of, and discuss, the response in terms of the graph's shape.

One major requirement of the IF channel is to compensate for the vestigial sideband transmission system. As we explained in the previous chapter, all but about 1.25MHz of one picture sideband is suppressed at the transmitter, this being the maximum amount of suppression which is practical at the present state of the art. This means that, for the first 1.25MHz on either side of the picture carrier, the system is essentially a double sideband system, and transmits twice as much sideband power as it does for higher frequencies, where the system is essentially single sideband.

To compensate for this the IF channel must be adjusted so that its response to the 1.25MHz double sideband signals is less than its response to the remaining single sideband signal, and by the correct amount at each frequency. Thus the response is "down" at the picture IF (say 36MHz) but increases steadily to 34.75MHz after which it levels off for the remainder of the picture response channel. This extends, in theory, for 5MHz, to 31MHz, although individual IF systems will vary in their ability to reach this value.

Beyond the 31MHz point the response is required to drop sharply before reaching the sound carrier IF at 30.5MHz. Here the response must form a plateau as wide as the deviation of the FM system (100kHz) and approximately 10pc of the height of the maximum picture signal response. The height of the plateau is moderately critical and is designed to ensure — for quite complex reasons — that picture signals do not appear at more than minimal strength in the sound system.

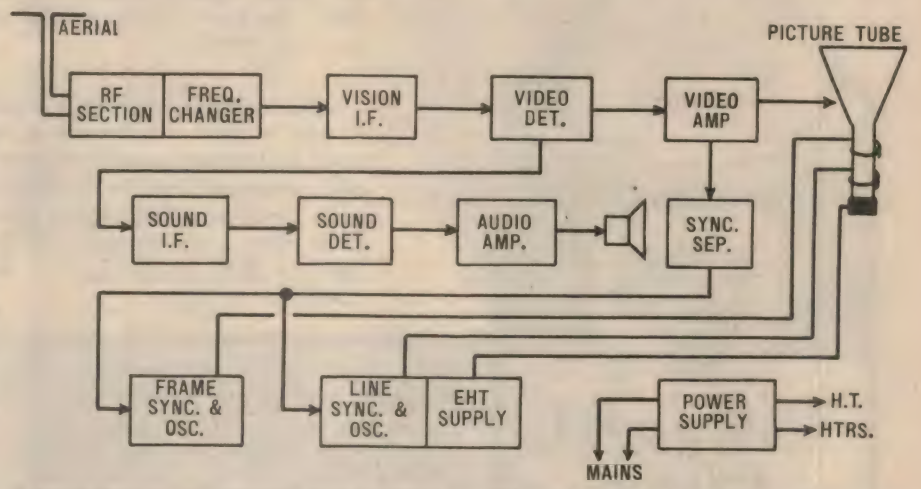
From the IF channel the signal goes to the picture — or video — detector. This functions in exactly the same fashion as the detector in a conventional sound receiver and is normally a diode — either valve or solid state. From the detector we get our video signal and, to ensure that the full video bandwidth is obtained, extreme care is taken to reduce stray capacitance to a minimum, and to boost the high video frequencies where necessary to offset any losses. The video signals then pass to the video amplifier.

However, another type of signal is present in the detector circuit and the manner in which this is used is one of the cunning tricks employed by TV engineers. The signal is a 5.5MHz beat, caused by the difference between the sound and picture carriers. This beat contains both FM sound and AM picture modulation but, by employing suitable limiting circuits, the AM content can be eliminated, leaving the FM sound signal only.

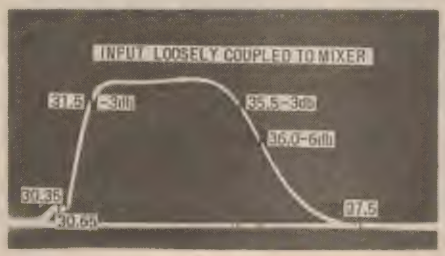
So, connected to the video detector we have an auxiliary IF amplifier, the sound IF amplifier, operating at 5.5MHz. It incorporates the necessary limiting stage and is followed by some form of FM detector which extracts the audio component and feeds it to a conventional audio amplifier. De-emphasis of the high audio frequencies normally takes place within this amplifier.

The main advantage of this form of sound system, called the **inter-carrier** system, is that it provides a high order of sound stability. The 5.5MHz IF is determined by the two transmitter carriers and thus remains absolutely constant, regardless of any drift in the receiver tuner. In older receiver designs (never used in Australia) the sound IF was as delivered by the tuner, and so would vary as the fine tuning control was adjusted. Careful adjustment of the fine tuning control was necessary to produce undistorted sound, while small orders of local oscillator drift in the tuners, having negligible effect on the picture, could seriously distort the sound.

To ensure that the inter-carrier system functions correctly, it is essential that the video carrier never be allowed to drop to zero. Should this happen, there would be no carrier against which the sound carrier could beat to produce a 5.5MHz IF, and there would be a momentary loss of sound. For this reason the transmission standards specify that peak white should never cause the carrier level to fall below a specified value (about 20pc) instead of to near zero,




*A block diagram showing the main sections of a TV receiver. All sets need to perform each of these functions, but may perform each one in a variety of ways, using either valves or solid state devices. Refer to the diagram as each section is discussed.*




*The "shape" of a TV IF amplifier displayed on a CRO. A practical curve, it comes very close to the theoretical ideal.*

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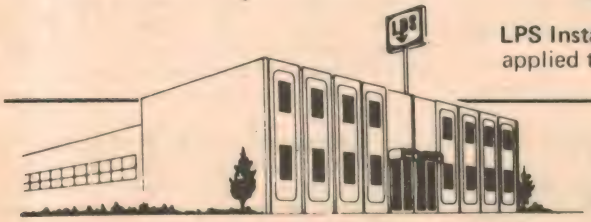

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which would be the natural assumption.

The inter-carrier system is the reason why the sound channel is so trouble-free in modern TV receivers. No matter how the set is tuned — or mistuned — the sound remains substantially undisturbed. This is a vast improvement on early designs, which were quite critical in this respect.

Reverting to the video signal as it comes from the detector this is then passed to the video amplifier. This is usually a single stage, although some designs may use two stages. The major requirement is a suitable order of amplification together with an adequate bandwidth, the latter requiring, nominally, to cover from below 50Hz to 5MHz. Careful design is required to achieve this, in regard to both the circuit and the physical layout. Stray capacitance must be reduced to a minimum and high frequency compensation used to offset losses which cannot be avoided. In addition, a 5.5MHz trap circuit is employed to reject the inter-carrier sound IF signal and prevent it from appearing as an interference pattern in the picture.

Somewhere in the video amplifier there is usually a variable gain control, which becomes the **contrast** control on the front of the set. This may be regarded as analogous to the volume control on a sound receiver. However, some designers prefer to associate the contrast control with other sections, such as the IF amplifier.

The output of the video amplifier is an amplified version of the composite video signal, ie, the actual video information plus the vertical and horizontal sync pulses. This signal is fed to the grid / cathode circuit of the picture tube, often via the cathode rather than the grid, for reasons of convenience. The fact that the sync pulses are included is of no consequence, since they are "blacker than black" as already explained.

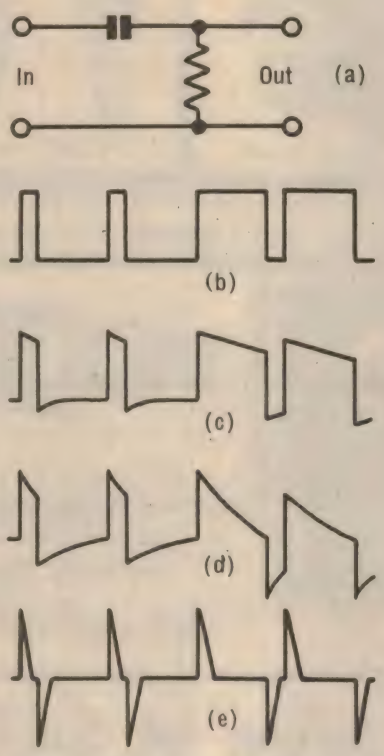
However, the sync pulses have not yet performed any useful function. Before they can be employed they have to be separated from the video information and the stage which performs this is called a **sync separator**. The sync separator is normally fed from the output of the video amplifier, thereby taking advantage of the amplification which this provides.

Separation of the sync pulses from the video information is based on the difference in amplitude between the two. The sync separator might best be described as an amplifier stage deliberately biased well beyond cut-off. Imagine a valve operating under conditions of low plate voltage and high negative grid bias. Such a stage would not function at all for signals of only moderate amplitude, but would function during part of the positive cycle if we applied a signal of sufficient amplitude.

In practice, we arrange that the video signal fed to such a stage will have positive going sync pulses. We also arrange the operating conditions of the valve so that the amplitude of the video information is just insufficient to overcome the bias. Only the higher amplitude positive-going sync pulses can do that, and so they appear as amplified pulses, minus the video information, in the plate circuit of the stage.

Since the amplitude of the video signal will vary widely according to the strength of the incoming signal, it is obviously not possible to use a fixed operating condition for the sync separator. Rather must it be able to adjust istelf to any likely signal amplitude. This is achieved by using the video signal itself to generate the bias for the stage. Each positive sync pulse drives the grid positive, causes grid current to flow and generates a voltage across a resistor in the grid circuit. This voltage is stored as a charge in a capacitor and is of such polarity and amplitude that it drives the grid beyond cut-off when the sync pulse finishes, and holds it there until the next sync pulse occurs.

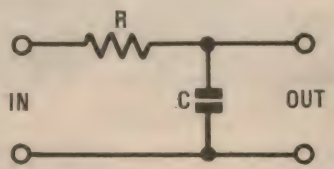
With the sync pulses effectively separated from the video, it is now necessary to separate the vertical and horizontal pulses




*A differentiating circuit (a) and a normal input waveform (b). Outputs (c), (d), and (e) result as the capacitor is made smaller. Waveform (e) is the one required.*

from each other in order that they may be directed to their respective deflection oscillators. The main difference between these pulses is their duration. The horizontal pulses are relatively short and occur 15,625 times a second. The vertical pulses are, individually, several times longer and, in addition, are presented in a block of five. This block occurs 50 times a second.

The two circuits used to separate these pulses are called the **differentiating** circuit and the **integrating** circuit. The differentiating circuit selects the horizontal pulses and the integrating circuit the vertical pulses. The differentiating circuit may be likened to a high pass filter, or one which does not respond to low frequencies. With associated circuitry it is made to respond to the leading edge only of all the pulses — vertical and horizontal.




*An integrating circuit. Compare it with the differentiating circuit above.*

The integrating circuit has opposite characteristics, and may be likened to a low pass filter, or one which does not respond to high frequencies. It ignores the horizontal pulses, but responds to the longer, individual, vertical pulses. These it adds together, or integrates, to make one large pulse.

The reason for using five separate pulses, which must be added together to form one large pulse, rather than simply presenting one large pulse, is to enable the horizontal pulses to be retained during this period. It will be remembered that we said that the differentiating circuit responded to the leading edge of all pulses and this fact makes it possible to continue to transmit horizontal pulses, in the form of serrations in the vertical pulse, while the latter is being transmitted. If this were not done, the horizontal oscillator would drift out of sync during each vertical pulse period, and might not be restored in time for the first lines of the new frame.

From the integrating and differentiating circuits the sync pulses are directed to their respective oscillators. The simpler of these two is the vertical oscillator, to which the pulses from the integrating circuit are directed, so we will consider it first.

This oscillator can take a variety of forms, but they all have one requirement in common — ability to be readily triggered by a synchronising pulse. Also, they invariably employ the same basic circuit, a resistor and capacitor in series connected across a supply voltage. Such a circuit will develop a steadily rising voltage across the capacitor, commencing at zero at the instant the supply voltage is applied and rising towards the supply voltage at a finite — and predictable — rate. The actual rate will depend on the values of the capacitor, the resistor, and the supply voltage, all of which may be made substantially constant.

This rising voltage, or a current derived from it, is used to move the scanning beam down the face of the picture tube, thus providing the vertical portion of the scan. When it reaches the bottom of the screen, means must be provided to return it quickly to the top and commence another downwards trace. This is done by rapidly discharging the capacitor, then leaving it to complete another charging cycle, and so on in a regular pattern. This pattern, when portrayed graphically, looks like the teeth of a saw and, in fact, is called a **sawtooth** waveform.

To discharge the capacitor we might envisage an ordinary mechanical switch which is closed just long enough for this purpose, then opened again to allow the next charging cycle to commence. Fairly obviously, a mechanical switch would be impractical in such a role, but we can use various forms of electronic switch. Typical examples are the thyratron, or gas triode, conventional "hard" valves, or transistors. Only the last two are employed in modern TV sets.

A popular arrangement uses the **blocking oscillator**. A blocking oscillator is one which is designed to alternately oscillate and "block" itself off by reason of its own oscillation. As with other types of oscillator, this type generates its own bias by reason of grid current, the voltage being developed across the grid resistor and stored as a charge in the grid capacitor. If these two

components are made large enough a burst of oscillation will not only generate enough bias to cut the valve off but this condition will be retained for a relatively long period until the capacitor can discharge through the grid resistor. When it has discharged sufficiently the circuit will again oscillate, and the blocking process will be repeated.

These short bursts of oscillation, separated by relatively long periods of inactivity, can be used to perform the switching function needed to discharge the capacitor in our sawtooth network. The blocking oscillator valve is, in effect, connected in parallel with the sawtooth capacitor, and discharges the latter when it conducts during the brief oscillatory cycle. The time between bursts of oscillation is made approximately equal to the vertical scanning period.

More precisely, it is made slightly longer. Then vertical sync pulses, of positive polarity, are fed to the grid of the valve. These over-ride the negative charge left on the grid, causing the stage to oscillate (and subsequently block) earlier than it otherwise would, and precisely in step with the signals radiated from the transmitter. Thus the vertical deflection circuits are exactly synchronised with the transmitter.

Another popular vertical oscillator circuit is the **multivibrator**. This requires two amplifying devices and typical circuits usually employ a twin triode valve. Although the oscillator functions in a somewhat different manner, it also depends on the rate of discharge of a capacitor to allow a valve grid to rise sufficiently above cut-off to function, and therefore can be triggered by a positive sync pulse if the natural frequency of oscillation is made slightly slower than is required.

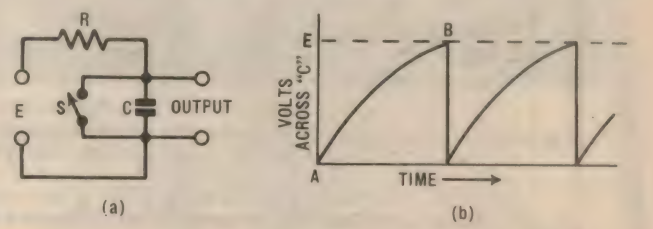
As a matter of interest, the natural rate of these oscillators is normally controlled by the vertical hold control on the front panel of the TV set. The user has to set it so that the oscillator stage is running slow and, although he may not appreciate what he is doing, he manages this quite easily by simply adjusting it until the picture locks. The amount by which the stage runs slow is not critical within reasonable limits.

The horizontal oscillator could use similar circuitry to that just described for the vertical stage, assuming that the values of the frequency determining components were changed to suit the line frequency (15,625Hz) rather than the frame frequency. In fact, such arrangements were used in early commercial receivers and may still be used in simple experimental sets. Modern sets use a more refined system which has a number of advantages.

The main disadvantage of the simple system is its tendency to trigger prematurely, due to random noise pulses present with the signal. Unless the signal is very strong, giving a high signal-to-noise ratio, noise pulses can be strong enough to be mistaken for a sync pulse, at the moment the oscillator is primed for triggering by either. The result is a degree of random sideways misplacment by successive lines which, though small, gives the picture a shimmering effect and renders it less acceptable than it should be.

The circuits which have replaced it are generally known under the broad title of **flywheel** circuits, though sometimes also referred to as **automatic frequency control** (AFC) circuits. (Do not confuse the term "flywheel" used in this context with the same term sometimes used to explain the behaviour of tuned circuits.) The flywheel circuits, as their name implies, behave as if they have considerable inertia. While they are synchronised by the station sync pulses, they will not respond to short-term changes — ie, from line to line — which may occur, or appear to occur, in the line pulses.

Since, in fact, such changes do not (or should not) occur in properly controlled transmissions, it is quite in order to employ a circuit which is incapable of responding to them. Should they seem to occur they must really be spurious signals and should be ignored.




*Basic sawtooth generator circuit, and a typical waveform. In practice, "S" is replaced by an electronic switch of some kind.*

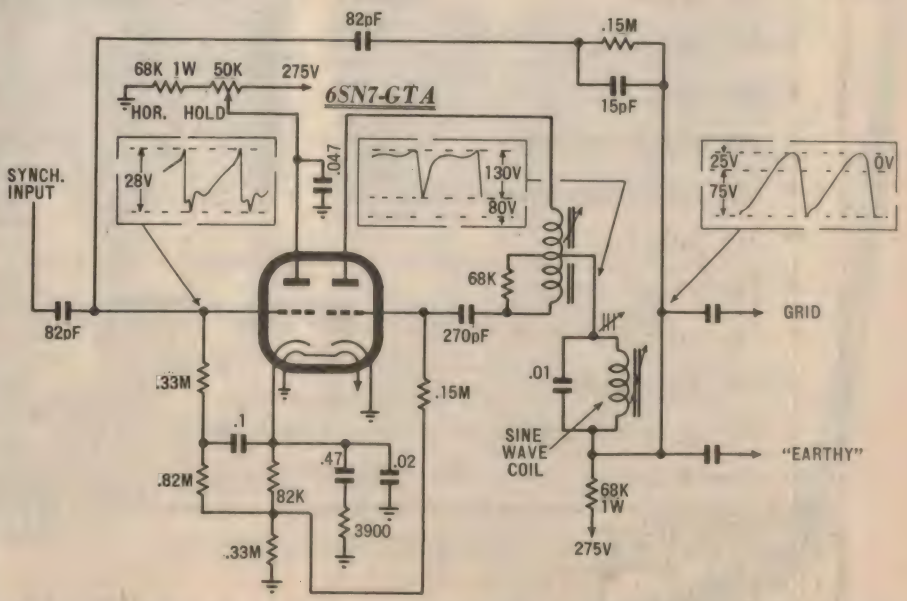
Such flywheel circuits take a number of forms, but many are based on the use of an oscillator of a type which can be readily controlled by the application of a DC control voltage. This voltage is produced by comparing the phase of a sample pulse taken from the output of the line oscillator, and the sync pulse from the transmitter. While ever these are in agreement, no correction signal is applied to the oscillator but, should an error occur, a correction signal is generated which changes the frequency of the line oscillator by the required amount and direction. However, capacitor networks associated with the control voltage give it a suitably long time constant.

In a discussion of this nature it is impossible to discuss all these circuits in detail. The best we can do is to give a broad outline. One popular arrangement, called the Synchro-Guide, uses a blocking oscillator similar to that already described for vertical oscillators. However, instead of feeding positive sync pulses to the grid of the valve to trigger oscillation at a precise moment, it is fed with the steady positive voltage derived from the phase comparator circuit. This opposes the valve's self-generated negative bias, more or less according to the value of positive voltage, and so varies the time between bursts of oscillation, or the rate at which the oscillator functions.

Another popular system uses a multivibrator oscillator in conjunction with a discriminator circuit. In this arrangement two sets of sync pulses, of equal amplitude and opposite polarity, are applied to a discriminator circuit consisting of a pair of diodes. To this network is also fed a sample pulse from the line oscillator and the comparison of these pulses results in an output which is either positive or negative according to whether the oscillator is running too slow or too fast. Applied to the grid of the multivibrator stage it will either speed up or slow down the repetition rate as required.

Neither the horizontal nor the vertical deflection oscillators are capable of generating the amount of power necessary to operate the deflection coils, and each must be followed by an output stage. This is a relatively heavy duty stage, similar in broad concept to the output stage in an audio amplifier. In addition to producing sufficient power, it must also preserve the correct waveform to ensure a linear scan. Magnetic deflection systems require a sawtooth current through the deflection coils, rather than a sawtooth voltage applied to deflection plates. Since the coils are partly resistive and partly inductive the waveforms involved are quite complex.

As nearly as possible, the required waveform is generated in the oscillator




*The Synchro-Guide. The right hand triode and circuitry is a conventional blocking oscillator. The other triode compares the sync pulses with line output pulses and generates a correction voltage at its cathode. This is applied to the blocking oscillator grid.*

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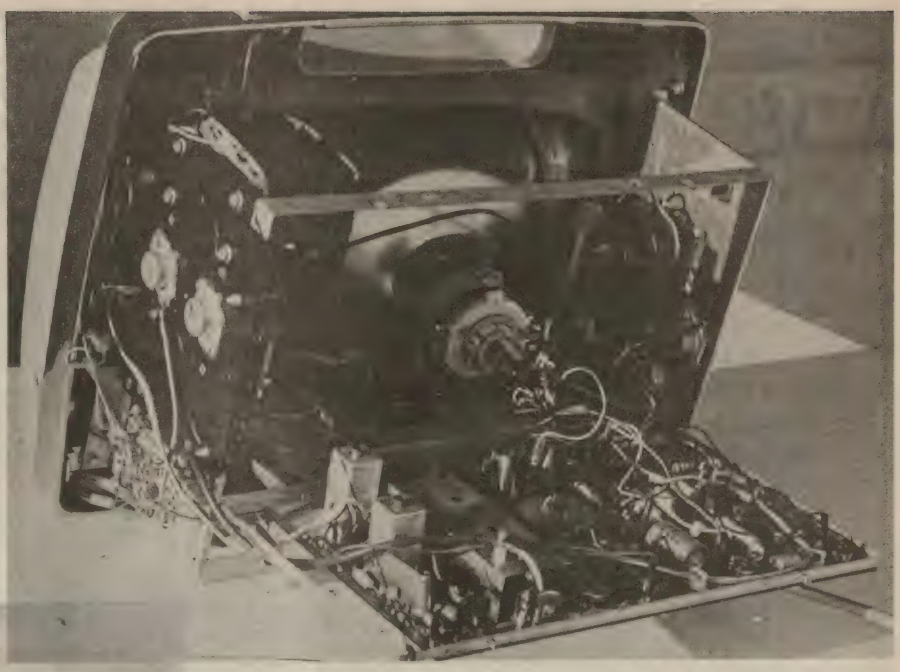
stage, leaving the output stage to function more or less as a linear amplifier. However, some compensation can be provided in the output stage and this stage may also carry the so-called linearity control. The vertical output stage is relatively straightforward, the power amplifier terminating in a transformer which couples the stage to the deflection coils and provides the necessary matching and DC isolation.

The horizontal output stage is a rather different proposition, and is another part of the TV receiver where engineers have resorted to a number of cunning tricks to either improve performance or reduce the number or size of the components required. The result of this "simplification" is, rather paradoxically, to make this part of the circuit one of the most difficult for the beginner to follow. Nevertheless, the logic of the circuitry becomes apparent when it is studied in detail and its performance understood.

Apart from its basic job of providing horizontal drive, this stage can be required to perform most of the following functions: Generation of the EHT (Extra High Tension) for the picture tube final anode, generation of an auxiliary HT supply called boosted HT, provision of gating pulses for gated AGC, and reference pulses for the horizontal oscillator flywheel circuit.



*Interior of an all-solid-state portable TV receiver. The compact layout is typical of what can be achieved using transistors and printed wiring. The EHT transformer with solid state EHT rectifier can be seen on the right hand panel. Picture by courtesy of AWA.*

The final anode of a TV picture tube requires a voltage of around 15,000, more or less according to the size and type of tube. Generating voltages of this order presented a problem in early designs, since it meant large and expensive power transformers and associated filter components. Later it was realised that, by using frequencies substantially higher than the mains, much simpler equipment could be used. Not only could the transformer be reduced to a fraction of its original size, but the higher frequency greatly simplified the filter circuits and reduced the capacitance required to a few hundred pF.

And, since there was a high frequency generator already in the set, in the form of the line output stage, it was a natural development to add an extra winding to this transformer, large enough to produce the required EHT. In modern sets the filtering often consists of no more than a small resistor and the capacitance between coatings on the inside and outside of the glass picture tube envelope.

The boosted HT supply is really a natural by-product of an essential part of the deflection system: the **damper diode**. The damper diode is used to suppress unwanted oscillations in the output circuit, generated by the abrupt nature of the waveforms involved. By the addition of a few extra components it is easy to add from 150 to 300 volts to the main HT line, providing a boosted HT supply of up to 600V and capable of supplying several milliamps. This is most useful for the deflection oscillator and output circuits, where the higher voltages simplifies the generation of linear deflection currents.

The gated AGC system does for a TV set what a simple AGC (or AVC) does for a sound receiver. It keeps the output very close to constant in spite of large variations in signal strength, particularly between stations. However, the circuitry to perform this function in a TV set is likely to be a good deal more complex than the sound receiver counterpart. One reason for this is simply the nature of the TV signal which, unlike the sound signal, is not a symmetrical one with a constant average output. On the contrary, the output of the transmitter varies continually, according to the light and shade of the picture.

While it is possible to provide a simple AGC system which uses the entire video signal, such an arrangement has limited use in commercial sets. What is needed is a system which will respond to the true signal strength of the transmitter, rather than one which is confused by the varying video content. The only constant level transmitted by a TV station is the sync pulse level, so an AGC system which can be made to "see" only the sync pulses will provide the type of control required. This is the basis of gated AGC.

This system is quite complex in itself and cannot be dealt with in detail here. Sufficient to say that the AGC circuitry is allowed to operate only during the period when sync pulses are being transmitted, from which it develops a steady DC control voltage for application to the tuner and IF stages. The system is made to measure only the sync pulses by "gating" it into operation with a pulse from the horizontal output stage which, naturally, occurs at the same time as the sync pulse.

The need for a pulse to provide a reference for the AFC system has already been discussed. This pulse is often taken from the horizontal output circuit. In other cases it may be taken from the horizontal oscillator.

The amplitude of horizontal signals generated in the output stage is quite high, and can easily cause interference with other parts of the set. For this reason a portion, at least, of the line output stage is built inside a ventilated metal box, called the **EHT cage**.

The power supply for the TV receiver is very similar to that used in sound receivers, except that it is a good deal larger. Early designs used valve rectifiers in conventional full-wave circuits, but these have been replaced by voltage doubler circuits using silicon rectifiers, with some saving in space and cost.

Throughout this discussion, explanations have been based on the use of valves for all the functions in a TV receiver. This is logical, since TV sets evolved around these devices, and they are still predominant in locally produced sets. However, all these valves (with the exception of the picture tube) can be replaced by solid state devices (transistors, diodes, etc.) and which will perform as well or, in some respects, better. A number of manufacturers, both locally and overseas, are producing all solid state TV receivers, both portable and full-size. Doubtless it is only a matter of time and economics before they replace valves completely in this role.

# Let's talk about crystal sets

Elementary Electronics

by Ross Tester

As a complete change this month we are going to talk about crystal sets; sometimes called the simplest radio receiver. As we will see, for a "simple" set, it is capable of a surprising number of variations, all having their particular advantages.

The crystal set was the first radio used by the public for broadcast reception. Its inherent simplicity was its main advantage, since it suffered from limited sensitivity, selectivity and signal output. When better sets became readily available it was soon discarded. Yet enthusiasts continually revive it from time to time, and

The invention of the germanium diode was the last straw as far as the crystal and cat's whisker were concerned but, rather strangely, created a mild revival for the "crystal set" itself. In one small package came all the features of the crystal detector, but with improved sensitivity and none of the disadvantages. Perhaps some

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for the "simplest radio set".

When I built my first crystal set nearly fifteen years ago, one thing really puzzled me. That was the name "crystal set". Nowhere had I seen a "crystal set" containing a "crystal".

I knew what a crystal was — it was a device used as a frequency standard. But there certainly wasn't one of those in my set.

I wondered whether I had left something out, but no — "Radio & Hobbies" (predecessor to "Electronics Australia") assured me I hadn't. Besides which, the darn thing worked!

The trouble was, I was born about fifty years too late. Had I made a crystal set early this century — or even later — I would have used what was then one of the first types of detectors — a crystal.

The crystal detector of fifty years ago bears absolutely no resemblance to the frequency standard crystal we know today. Whereas the latter is a crystal of quartz, very accurately cut and mounted, the crystal detector resembled, to some extent, a small lump of shiny coke.

This material was actually galena, or lead sulphide. It was not just one crystal, but a crystalline structure. To make contact with the crystal, a fine wire was used to press against the surface. This could be moved around the surface of the crystal to find the best position. The wire assembly was known as a "cat's whisker".

Even though the cat's whisker and crystal were not forgotten, the invention of the thermionic valve led to their eventual demise. From the late 1920's radio receivers began to move away from the novelty stage, and crystal sets were left to the experimenters.

*One view of the crystal set we are describing this month. The coil is at the top of the picture with the taps, wound over a match, clearly visible. Note the wander leads from the taps. There are a number of ways in which appearance could be improved, such as fitting a panel and dial scale behind the knob, or building the entire set in a wooden or plastic box.*

transistor radios use diode detection in exactly the same way as in the crystal sets to be described.

A crystal set is interesting because it performs, at an elementary level, all the functions needed to receive a radio signal, and most of those performed by larger sets. Granted, it does not do all of them particularly well, but an understanding of what it does and where it fails provides excellent grounding for understanding more elaborate circuits.

It is not difficult to understand how a radio receiver processes a transmitted signal, at least at an elementary level. A first requirement is to understand the nature of the signal. This consists of a radio frequency "carrier" which is "modulated" by the speech or music we wish to transmit. The modulation is achieved by varying the amplitude of the carrier at the frequency of the signal. (Hence, amplitude modulation). Thus, if we wish to transmit a 1000Hz note we cause the carrier amplitude to vary 1000 times a second.

Reception of such a radio signal requires that we provide four basic facilities; (1) means to intercept a portion of the radiated signal, (2) a means to separate the wanted signals from unwanted ones, (3) a means to extract the audible ("audio") information from the radio frequency **carrier**, and (4) a means to convert the audio signals into sound.

For (1) we use an aerial or antenna system. Considered at its most basic this is simply two plates of a capacitor. Traditionally, one plate is the aerial wire and the other plate the earth. However, the second plate can take a number of forms. It may be a second aerial wire underneath the first (a counterpoise), the metal frame of a vehicle (car or aircraft) or the metal body of a ship and the surrounding water. Generally, the larger the plates and the greater the distance between them, the more signal will be intercepted.

For (2) we use a tuned circuit or, in more elaborate sets, a number of tuned circuits.

## ELEMENTARY

A tuned circuit consists of two components; a capacitor and an inductor. The exact manner in which it works is quite complex, and somewhat beyond the scope of an article like this. Suffice it to say that any given combination of inductance and capacitance will resonate at a particular frequency. We make it resonate at the frequency of the station we wish to receive.

In our crystal set the tuned circuit is coupled to the two sides of the aerial system. At resonance, it allows the maximum signal voltage to be developed across it. Signals at any other frequency will develop a lesser voltage. By varying the inductance, or capacitance, or both, we can adjust the resonant frequency and select the signal we want.

For (3) we use our much discussed "crystal" or the diode which has replaced it. It can be considered simply as a half wave rectifier. (Remember our articles on power supplies?) The diode clips off one half of the cycle, leaving either a positive or negative going waveform.

Remember how we described an amplitude modulated signal? How the carrier strength (amplitude) varies up and down at the frequency of the modulating signal? Well, it is these variations in strength we wish to recover.

Since the carrier frequency is much too high for us to hear, neither can we hear any changes in its strength. As far as the ear is concerned each half cycle of the carrier occurs so rapidly after the previous one that it might just as well have occurred at the same time. As a result the two halves effectively cancel one another.

But if we remove one set of half cycles (with a rectifier) the remaining ones will all be effective in the one direction. While we still cannot hear the carrier frequency, we can create a new signal which is an exact copy of the changes in the carrier amplitude. This is our audio signal.

This brings us to requirement (4); a means to convert the audio signal into sound. For this we use a pair of earphones. In their most common form these are magnetic devices; a coil of fine wire on a magnetised pole piece is mounted close to a thin metal diaphragm. When a varying current flows through the coil it causes the diaphragm to vibrate in sympathy with it. This vibration we hear as sound. This is necessarily a much simplified explanation of the earphone; also other types operate on quite different principles.

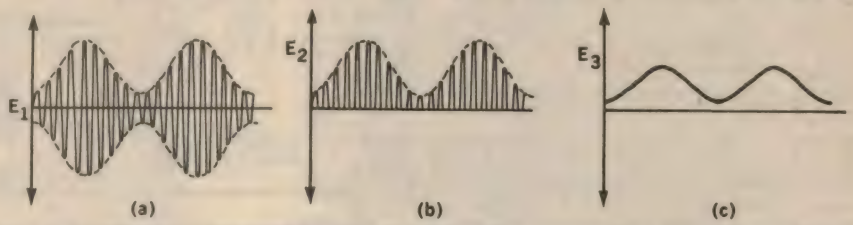
But it is not hard to see how a series of RF pulses, all operating in the same direction, will behave when applied to such a device. Each pulse will try to move the diaphragm, and will succeed to some extent. Each following pulse will have the same effect and, because they occur so rapidly one after the other, each will reinforce the previous one. The inertia of the diaphragm is too great to allow it to respond to the gaps between pulses but not so great that it cannot respond to the relatively slow variations in the strength of succeeding pulses.

As already explained, tuning the set involves adjusting the resonant frequency of the tuned circuit. There are three ways of doing this — adjusting the capacitor and leaving the inductor fixed, adjusting the inductor and leaving the capacitor fixed, or, in some cases, adjusting both the inductor and capacitor.

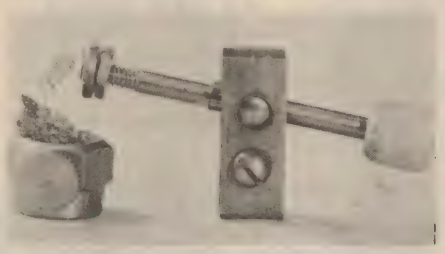
Most readers will be familiar with tuning capacitors — a device with two sets of plates, which can be adjusted so that the area they have in common changes. When the plates are fully closed ("in mesh") they provide the maximum capacitance obtainable (usually about 400 picofarads). Conversely, when they are wide open they are at minimum capacitance (usually about 10 picofarads).

Instead of varying the capacitance we can vary the inductance, and there are a number of ways of doing this, which we will discuss in greater detail later.

But now, let us look at our most popular crystal set. This one has become our "standard" model, because it is about the simplest and easiest to make. The parts involved are readily obtainable from either the junk box or your normal parts supplier. You should be able to "scrounge" some of the parts, at least.




*At (a) an amplitude modulated RF carrier, the dotted line representing the audio modulation. At (b) one half of the carrier has been removed by the diode and at (c) the audio signal derived from the outline of the RF carrier.*



*A crystal detector. The crystal is in the cup on the left and the coiled wire is the "cat's whisker" on a movable arm.*

For example, you should find a tuning capacitor in almost any discarded receiver — do not worry if it has more than one section — it is still quite useable, as we will explain.

The only item you may have trouble procuring is the headphones. The circuit calls for 2000 ohm (or higher) types, but there are not many of these around these days. We managed to locate a small supply — exactly how many we are not sure — but they are rather pricey. Deitch Bros, of Oxford St, Sydney, have some in stock, at around $4.50. Perhaps disposals stores in other states may be able to locate some.

Many readers may not be willing to pay so much for a set of headphones which, we agree, have strictly limited value. Also, (as many of our older readers will remember) high impedance headphones were never particularly reliable.

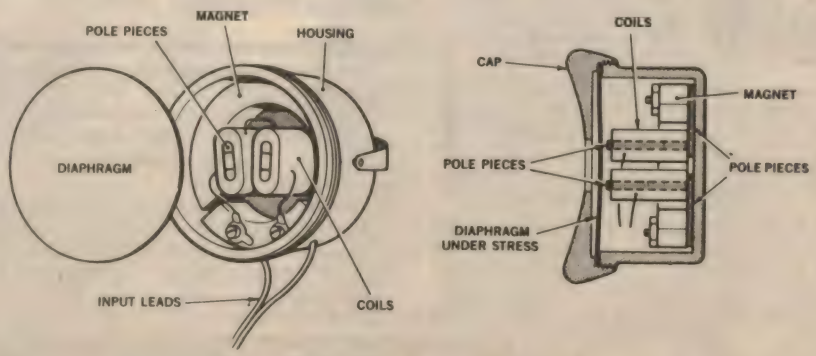
Our solution is to use a set of low impedance (hi-fi type) headphones. The cheapest of these are about the same price as the high impedance types, but have much more use. They are not likely to be stored away as soon as the project is finished.

The trick is to use a speaker transformer between the crystal set and the headphones. We used a Ferguson type E5K15, which, as the type number suggests, is a 5000 to 15 ohm type. Ferguson Transformers supplied this to us some time ago for a completely different purpose, but it works well in this role!

Ferguson Transformers assure us that they have these transformers in stock, but should they run out, they have other types which are equally suitable. These have a 7000 ohm primary and 15 ohm secondary — type numbers E7K15 and K7K15.

Again most valve amplifiers and radios will have a speaker transformer, and the primary impedance will seldom be less than 5000 ohms. It is best to use a type which has a secondary impedance close to that of your headphones, but do not worry too much about this.

The first headphones we tried were an expensive pair (Stantons) which were in for review! The individual phones were connected in series to give the best load impedance, but this does not matter all that much. (Normally, each 8 ohm phone is driven from a separate stereo channel).




*Construction of typical magnetic headphones. The permanent magnet provides an initial mechanical bias for the diaphragm, which then moves in or out according to the polarity of each half wave of AC (audio) signal applied to the coils.*

We also tried a pair of cheap stereo headphones — the cheapest we could find — at about $5.00. While no one would pretend that these sound anything like as good as a pair costing ten times as much, such as the Stantons, in terms of sensitivity and for the very simple role we used them for they compared quite favourably. (They still sound a lot better than most of the old fashioned 2000 ohm types).

The headphones are easily arranged with the voice coils in series. Take note of the headphone plug (usually a 6.5mm jack plug). You should see three distinct sections — the tip, then a ring of insulation, another band of metal, another ring of insulation, and finally the main metal body of the plug. Disregard the main metal body, and make the receiver connections to the tip and first band. It is easier to do this using a suitable socket. These connect to the "hot" side of both voice coils, effectively connecting them in series.

With a good aerial, this set will give quite reasonable volume in the headphones. With an exceptionally good aerial, results are outstanding.

Our aerial is exceptionally good! On top of the building, 16 floors up, there is a tall radio mast to provide communication with our many cars. From the top of this mast we have an aerial which runs right down to our 12th floor laboratory.

With this aerial, the volume obtainable from the crystal set is positively deafening using either the eight or 2000 ohm phones. Because it was so loud, we tried connecting a speaker to the transformer. It was loud enough to hear clearly across the laboratory!

We do not expect readers to be able to duplicate our aerial system, but with a good aerial close to the transmitters, some readers may obtain enough power to drive a speaker. If you want to try this, keep the following points in mind:

Use the largest speaker you can find. Contrary to popular belief, a large speaker is not harder to drive than a small one. Rather the larger one will normally be many times more efficient.

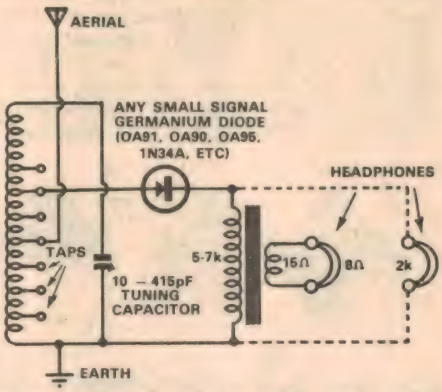
Now that we have explained how it works, we can get down to building the actual device. The best place to start is the coil.

You will need approximately 15-20 metres of 22-24 B & S enamelled copper wire and a stiff cardboard former. The one we used was a cardboard mailing tube, approx 5.5cm diameter. If thin wall cardboard tube has to be used, it would be wise to give it one or two coats of clear enamel to stiffen it.

The tube should be long enough to allow easy working — say 15cm or so. It can be trimmed after the coil is completed. Incidentally other non-metallic materials can be used for the former, such as a plastic bottle. (A Phisohex bottle does nicely).

Start by drilling two 1/16 holes, close together, near one end of the tube. Pass about 15cm of wire through one hole then the other, several times, to provide a secure anchorage. Then wind on five turns (either direction, it doesn't matter) and make a tap. This is to be repeated every five turns.

The easiest way to do this is to wind the tap turn over a match. The match can be pushed up the coil as the turns progress. While we used ten taps on the prototype, we recommend seven. We found that only seven of the taps are useful — and it is easier to wind without taps.




*Circuit of our crystal set. The main point with this version is the use of a speaker transformer with low impedance earphones.*

After the seventh tap (35 turns) wind on another 35 turns, making seventy in all. This number will be adequate for coil formers close to or the same as ours, but may have to be changed slightly for readers who (a) use different size formers or (b) have a station close to either end of the band.

If the coil cannot pick up stations at the high frequency end of the band, take a few turns off. If it cannot pick up stations at the low end, add a few turns.

As can be seen from the photo, the start, taps and finish are all in one straight line.

To finish the coil, drill another pair of 1/16in holes, and pass at least 15cm of wire through them, as before. This wire goes vertically through the coil centre, and emerges through another hole near the bottom. This makes a neat coil and keeps the windings tight.

We used a small tagstrip to mount the diode and provide tags for the headphones connection. A flying lead makes connection from the detector to the tap required. The same system is used for the aerial connection.

On the same tagstrip, connections to the impedance transformer are made. Separate tags are used for low impedance and high impedance headphones.

There are a number of ways of fastening the coil to baseboard, but avoid using metallic parts. Metal near the coil may not only change its inductance, but could effect what is called the "Q". The Q is a measure of the quality of the coil — and it should be as high as possible for optimum results.

We glued our coil former directly onto the baseboard. Aquadhere or a similar wood glue does the job nicely. The aerial and earth terminals are screwed directly into the baseboard, with a solder lug under each. A single length of stiff tinned copper wire runs from each terminal to its respective connection.

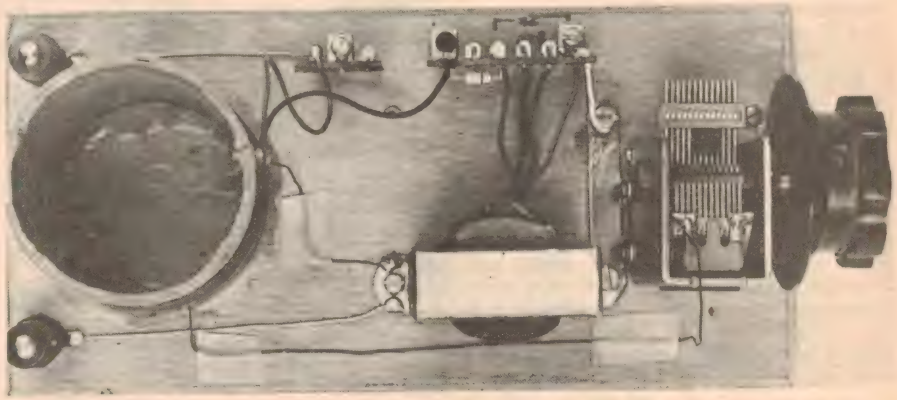
The tuning capacitor and impedance transformer, can be mounted so that they share a common mounting hole — a convenient arrangement, as we will explain. All parts are screwed into the baseboard using number 4 self-tapping screws.

Because the capacitor and transformer are connected, the connections from the earth terminal need be connected only to the transformer case, simplifying connection. The components on the tagboard are connected by a short length of wire to the capacitor frame.

We fitted an extra three lug tagstrip on the baseboard. One lug connects to the aerial terminal, and another to a tap on the coil. This was for an experiment which we will discuss later. For the present, the two lugs are simply joined together.

Use of the crystal set is simple. It does, however, depend on a good aerial and an equally good earth. Remember that there are no power connections, so the set is not earthed through the power cord. You must provide an external earth, preferably a water pipe or a metal stake driven well into moist ground.

Connect the aerial and earth to the terminals, the aerial terminal to a tap about midway up the coil, and the diode to the one below — toward the earthy end. Connect your headphones, and you should hear signals when you tune the capacitor. If not; try changing the taps.



*Plan view of the finished set. Layout is not at all critical but, if in doubt, follow our arrangement. The diode, which replaces the old fashioned crystal, can be seen on the tagstrip at the top of the picture.*

The best aerial and detector taps will be found by experiment. The higher taps will give the loudest signal, but poor selectivity, and vice versa. A compromise is necessary depending on your location, size of aerial, etc. Use the highest taps which will allow you to separate the stations.

This, then, is our basic crystal set. Next month we will describe a number of variations on the crystal set theme; each one designed to exploit one or other of the novel characteristics of the "simplest radio set".

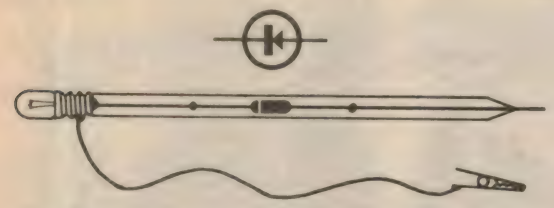
# Elementary Electronics Ideas Worth Trying

## Continuity and Polarity Indicators

Here are two ideas, submitted by different readers, for simple continuity and polarity testers. Considering the care necessary to ensure that certain solid state devices are not connected with wrong polarity, one or other of these would be handy on any experimenter's bench. The simpler of the two is described first.

Here is a handy instrument for the home experimenter. It is a polarity tester which is very simple and easy to make.

It consists of an OA81 germanium diode and a 6V, 0.32A bulb connected in series. These are fitted in an empty ball point pen tube (the ink tube removed).



Two short pieces of stiff copper wire are soldered to the diode leads. (Use a heat sink when soldering.) The one connected to the anode is pushed into the top of the tube and out the writing end. Secure this with insulation tape, leaving about 10mm of bare wire to form the positive terminal.

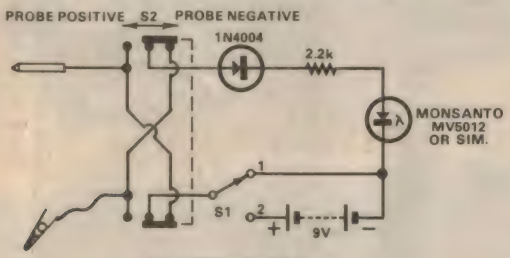
Trim the cathode wire close to the top of the tube and solder it to the bottom terminal of the bulb. Solder a third wire to the outer casing of the bulb and fit a suitable plug or clip to the other end. Finally tape the bulb to the top of the tube.

In use, the bulb will light when the pen terminal is on the positive wire and the flying lead on the negative.

(Mr N. Williams, 12 Borrows St, Virginia, 4014 Queensland.)

The second idea is a little more elaborate and versatile.

This is a continuity and polarity tester using a light emitting diode. It can be housed in any container large enough to hold a small 9V battery, two switches, a LED, a diode and a resistor.




S1 : 1 : VOLTAGE TEST
2 : CONTINUITY TEST

The tester indicates polarity of a DC voltage, indicates an AC voltage, and responds to pulses of AC or DC. It may be used on voltages greater than three and less than 100. As a continuity tester it gives a faint glow with a 100k resistor in circuit. It does not load a circuit as much as an ordinary test lamp and covers a voltage range which would require a selection of several conventional lamps.

(Mr R. J. Quick, 25 Fraser St, Sunshine, Victoria, 3020.)

## False Neon Indications

Because of their very low current consumption, 240V neon indicating lamps will often glow or flicker even though the associated circuit is switched off. This problem generally arises from cable to cable capacitance when neons are used for remote indication.

An effective solution is to bypass the lamp with a 100k resistor (1W for 240V). This provides an effective path for the leakage current but will not effect normal operation.

I have used this method widely with 100pc success. In 415V applications it is more expedient to use a 220k resistor, allowing a 1W type to be fitted.

(Mr P. Symonds, Flat 2, 15 Johnson St, East Balmain, 2041.)

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SN142

# CLASSICAL RECORDINGS

Reviewed by Paul Frolich

## *Victoria de los Angels — Canteloube, Chausson*

**VICTORIA DE LOS ANGELES, soprano — CANTELOUBE: Songs of the Auvergne; CHAUSSON: Poeme de l'amour et de la mer. The Lamoureux Orchestra, Paris, conductor Jean-Pierre Jacquillat. H.M.V. stereo OASD 2826.**

The Chants d'Auvergne, collected and arranged (and composed?) by Joseph Canteloube, who died as recently as 1957, have become widely known and loved, thanks to the quite magnificent recordings of about a dozen of them by the late Madeleine Grey. These were made in 1930 and re-issued on LP on several occasions.

More recently, a greater number of the songs from Canteloube's collections have been sung by Netania Davrath (among others) and, although her recording is very beautiful, it fails to evoke the magic of Madeleine Grey. Victoria de los Angeles, despite her sophistication and attainments in far more exalted fields of music, does a great deal better and, in fact, is even more persuasive than Miss Grey in some of these truly delightful items. Some of her success, one supposes, is due to the excellent assistance from conductor and orchestra, but the songs suit her and probably would have succeeded in any combination.

As far as I'm concerned, the songs of the Auvergne, old and loved favourites, could hardly be heard to greater advantage than here. If the disc is more than just a routine success, this is because of its remaining contents.

I had not previously heard Chausson's opus 19, a cycle of three songs based on (rather poor) poems by the composer's friend Maurice Bouchor. Half-way between turgid romanticism and early impressionism, these songs are about the finest music written by Chausson, who died in 1899, before the full flowering of Debussy's music, which owed much to his efforts.

In recent years, relatively little has been heard from the Lamoureux Orchestra and their present conductor is one I'd not heard of before. On the strength of this disc, they may once again be an ensemble worthy of serious consideration; the playing is excellent, with outstanding work from the wood wind sections and I am very much taken by the acoustics of the (Paris?) studio used for this LP.

To sum up: Chants d'Auvergne, if different in detail, every bit as good as from Madeleine Grey; Miss Angeles' occasional folksy archness serves very well indeed. The Chausson cycle is, for me, an important find and a major asset to the French repertoire. Singing, playing and recorded sound are tops and the disc may well become a treasured classic; James Harding's notes are sound and non-promotional and my only regret (a minor one) is the lack of an insert giving the texts of the songs.

★ ★ ★

**ITZHAK PERLMAN plays PAGANINI: Violin Concerto No.1, D major, op.6 and SARASATE: Carmen Fantasy, op.25 with the Royal Philharmonic Orchestra conducted by Lawrence Foster. H.M.V. stereo OASD 2782.**

This disc was, one presumes, issued to coincide with Perlman's tour for the A.B.C. — fair enough. I was one of those who were not completely bowled over by this quite remarkable young fiddler — neither by his virtuosity nor by the brilliantly managed publicity which surrounded his first Australian tour.

Itzhak Perlman is indeed a marvellous fiddler in the grandest possible tradition and his technical perfection is beyond dispute. At the same time, one must acknowledge that his tone is small and there has been little to prove him a musician the equal of either Ashkenazy (with whom he appeared in recital) or Pinchas Zukerman, the previous year's wunderkind, who was far more convincing.

As for this record, I do not, at present, know of any other version of the Paganini D major concerto which would be superior to this one.

This is not a concerto I often listen to, but I'll be quite happy with Perlman and his vigorous, yet quite sensitive interpretation. The R.P.O. contribute much that is enjoyable to this occasion, but the record's balance seems somewhat biassed towards the winds and there are a few untoward "booning" effects which I could have done without.

Sarasate's "Carmen" Fantasy seems an odd item to couple with the concerto unless one's opinion of Perlman is akin to mine. In any event, he plays the work at least as well as did Ricci and Kogan on the only other versions known to me.

★ ★ ★

**THE ADELAIDE WIND QUINTET — TCHAIKOVSKY: Nutcracker Suite; WAGNER: Siegfried Idyll; BIZET: L'Arlesienne Suite; MUSSORGSHY: Pictures at an Exhibition. H.M.V. stereo OASD 7570.**

The Adelaide Wind Quintet, whose recitals for Musica Viva and various festivals I've enjoyed for several years is, as Kenneth Hince says in his efficient cover notes, one of the finest and most beautifully integrated ensembles.

Mr Hince also bemoans the fact that the repertoire for wind quintet is very restricted; he further mentions that a number of Australian composers have specially written works for this group. Additionally, though the repertoire is restricted, it is far from non-existent, as listeners to this disc might be led to suspect. I have heard at least a dozen different works from this combination and know of at least a dozen more.

The regrettable fact is that none of the music here presented was written for wind quintet. The 4 pieces from Nutcracker, the 3 from Arlesienne and the 6 from the "Pictures", to say nothing of the Siegfried Idyll, are all arrangements by Dr William Lovelock, Brisbane. They are quite good arrangments and they are indeed quite excellently performed — but they are not from the repertoire that brought this ensemble such resounding success, both here and on their overseas tours.

To be specific: the Tchaikovsky pieces and some of the other very short ones come off pretty well and they are useful in demonstrating the players' versatility and degree of musicianship. The Wagner, after a very promising beginning, is a disaster; at nineteen minutes it is far too long and outlasts any possible interest one might have in so unusual an arrangement by a terrible margin. Balance and acoustics — far from easy to achieve for winds — are pretty good, but the recording studio was a bit too lively, especially for the resonant horn.

One is bound to congratulate E.M.I. for making recordings in Australia, at long last, and for using such fine performers — the more so as, on this occasion, they appear to have done the job without a subsidy. What a pity, though, that they did not see fit to choose worthier material!

★ ★ ★

**NEW YEAR IN VIENNA — Vienna Philharmonic Orchestra, conducted by Willi Boskovsky. Overture, Polkas and Waltzes by Suppe, Johann Strauss father & son, Josef Strauss, Lehar and Ziehrer. Decca stereo SXLA 6572.**

There is a tradition of a new Years' Eve concert by the Vienna Philharmonic Orchestra at which, year after year, works such as the ones on this disc are played and, usually, under the direction of the orchestra's concert-master. Lest anyone should believe this recording to be of such an occasion, the jacket clearly states that the recording was made in April 1972 and in the Sofiensaal — where most of the famous Viennese recording originated.

Let us be clear on this: April and NOT New Year and in what is almost regarded a studio, rather than the normal concert site for this orchestra. If I seem to be making a fuss it is only because the above are the reasons for its being quite a splendid recording, far better than yet another live one, made on New Year's Eve could have been.

Musically, this disc is not of great importance — the fact is, of course, that the best of the Strauss works have been so well done before (by this same team) that only a few old favourites could be included again.

Light entertainment then — but of the very best kind, marvellously played, very idiomatically directed and quite superbly recorded. Connisseurs of Viennese music will, I think, be particularly pleased with Suppe's overture to "The Beautiful Galatea". It is very beautifully played and, with the other less-well known "Gold &

---

Julian Russell is currently overseas, and in his absence, Classical Recordings are being reviewed by Paul Frolich.

## CLASSICAL RECORDS

Silver" Waltz by Lehar and the cheeky Ziehrer item, makes this a disc all whistlers-along will love.

★ ★ ★

**SCHUBERT — Piano Sonata in C minor, D.958; Impromptus op.90, D.899. Alfred Brendel, piano. Philips stereo 6500 415.**

Despite the immense respect and considerable affection I feel for Brendel, I have often been very unhappy about his way with Schubert. As it happens, he recorded this — the first of three wonderful sonatas written by Schubert in his last year — some three or four years ago and when we last met, in 1971, I was so upset by this performance that I even argued with Brendel about it!

Alfred Brendel is one of the most serious, and introspective, of to-day's keyboard masters; he analyses in great depth whatever he is going to play, he does considerable reasearch, thinks it over at great length and then emerges with a thoroughly reasoned interpretation. Luckily, for him and for us, he repeats this same process, for the same score, at fairly short intervals and we thus get several, often widely divergent versions from this remarkable musician.

This performance of the C minor sonata is a good demonstration of Brendel's methods. One may, possibly, find minor fault with a tempo here, a phrase there. For me, after recovering from the initial surprise, this version will certainly be THE one for some time to come — as it happens, I know of no other currently on disc and doubt that a better one will come along.

All the complexity of the score, all the beauty of Schubert's melodies, all the intricacies of modulation are here to be marvelled at and be enjoyed.

The four Impromptus, first published in 1827, are also heard to great advantage. Many Schubert lovers may well consider Brendel's approach to be unduly earnest and they might prefer a more light-hearted or frivolous reading. In this case, as there are quite a few competing versions, many of them good, available, I see no harm in having a rather different and more searching one for comparison.

The record is distinguished by a very fine piano tone and agreable acoustics, almost sufficiently mellow to suit even my prejudices!

★ ★ ★

**BRUCH — Violin Concerti No. 1, G minor, op.26 and No.2, D minor, op.44. Yehudi Menuhin, violin, with the London Symphony Orchestra, conducted by Sir Adrian Boult. H.M.V. stereo OASD 2852.**

Bruch's G minor concerto is one of the best-known of old warhorses and I had no particular desire to hear it yet again. In the event, I was quite wrong and Menuhin convinced me that it has not become and remained a favourite without good reason.

At some time, every fiddler of note has recorded this piece and I find, on my shelves, interpretations by Heifetz, Oistrakh, Francescatti and even an earlier one by Menuhin himself. In their various ways, they all play the concerto very well and beautifully, with a lot of virtuosity and panache. None of them, including the younger Menuhin, play it with so sweet a

tone and so persuasive a musicianship. It is, it turns out, not a pot-boiler at all, but quite a fine example of 19th century writing.

With the best will in the world, the same cannot be said for the D minor work. It has been previously recorded at least once — by Mischa Elman on a 1958 Decca issue, with the same orchestra — but I could not recall anything of that event. The reason is now clear: it is a remarkably non-memorable piece and even Menuhin's sweet tone and the quite decent orchestral playing cannot disguise its basic poverty. Once again, one discovers that success and failure are not necessarily based on caprice! Despite the boredom of side 2, however, remember that this is probably the best ever recording of the G minor concerto.

★ ★ ★

**HAYDN — The Seven Last Words (Version for String Quartet) Amadeus Quartet. D.G.G. stereo 2530 213.**

This work, a succession of eight slow movements and a fast finale, exists in orchestral, choral, keyboard and quartet versions, all of them by Haydn or largely so. To add to the confusion, it is often referred to as "opus 51" and many listeners are not even aware that it is a single work (not a succession of compositions), the full title of which is "The seven last words of our Saviour on the cross".

The work was written in 1785, specifically for performance by an orchestra, during a traditional Lent service in the church of Santa Cueva, Cadiz. As far as I am concerned, the string quarter version is the most moving and the most beautiful of all the different settings. As mentioned, there are 8 slow movements: the Introduction and the "Seven Words", followed by a short and furious Presto, "The Earthquake".

Not surprisingly, many people find the prospect of eight slow movements rather daunting and expect boring monotony. This is far from the facts; Haydn expressed much of his finest feeling in slow movements and these eight, ranging from stark despair to sweet resignation, are among the greatest works written by him. There is an infinite variety of emotions in these pieces and it is music one cannot easily tire of.

The Amadeus Quartet are among the world's leading Haydn specialists and this work, it seems, is particularly dear to them. They perform it regularly and have now recorded it for the second time — Westminster XWN 18055 was released about a decade ago. Their interpretation of the score has hardly changed over the years — the main difference is in the quality of the new D.G.G. recording which is certainly superior.

The playing by the Amadeus is simply flawless and I commend this disc to every true lover of fine music.

★ ★ ★

**MOZART — Symphonies No.40, G. minor, K.550 and No.41, C major, K.551 ("Jupiter"). Berlin Philharmonic Orchestra, conducted by Herbert von Karajan. H.M.V. stereo OASD 2732.**

About two years ago, E.M.I. issued a set of the last six Mozart symphonies, recorded by Karajan; they were, as I heard in England at the time, received with much enthusiasm and it is good to see that they are now to be made available individually.

Unlike many, I am not one who believes Karajan can do no wrong — I've often disliked particular performances of his. When it comes to Mozart, though, Karajan really has a magic touch and never allows his own personality to domineer the composer's (I wish he had as much respect for Verdi and others!); to him, Mozart is no rococo figurine, but a flesh-and-blood writer, yet not one to be unduly dramatised.

In an older recording, with the Vienna Philharmonic, Karajan was not yet as sure of his style for Mozart and I certainly prefer this later effort, quite apart from the decidely superior orchestral playing and the brilliance of sound on this disc. There is, probably, no crying need for yet another recording of Mozart's final two great symphonies, but these performances are so wonderfully fine in every respect that I hope many readers find they have not got a recording of them on their shelf already. Better Mozart will be hard to find!

★ ★ ★

**BACH — Cantatas: No.74, Wer mich liebet, der wird mein Word halten; No.147, Herz und Mund und Tat und Leben. Ileana Cotrubas, Julia Hamari, Kurt Equiluz, William Reimer; Netherlands Vocal Ensemble, German Bach Soloists, conducted by Helmut Winschermann. Philips stereo 6500 386.**

For me it is, regrettably, a rare event to be hearing Bach Cantatas and a disc such as this one gives one quite a guilty feeling at such personal neglect. The Cantata No.147, is well enough known — its fame is based on the chorus which we all love in its other form, "Jesu, joy of man's desiring"; even so, I had forgotten just how much other splendid material it contains.

Cantata No.74 is one I'd not heard on disc before this. Much shorter, it was written for Whit Sunday and though it contains a lot of delightful music, it is both less interesting and more difficult for the choir.

The most attractive parts of No.74, to me, were the solo arias and their stylish accompaniments, using oboe da caccia and violin, the latter quite splendidly played by Saschko Gawriloff. Of the singers, the men succeed better than the ladies; to me, the weakest link was soprano Cotrubas who, though stylish, simply is not right for the music — for proof of this, compare her with any Bach performance by Elly Ameling or Edith Mathis.

This detail apart, the disc has much to commend it. The singing of the Netherlands Vocal Ensemble is clean and spirited, Winschermann's tempi are brisk enough and all the instrumental playing is quite brilliant. The recorded sound is, to my ear, decidedly dry and lacks the kind of resonance one gets in a good cathedral. All the same, it is very acceptable and the disc is excellently engineered.

★ ★ ★

**BRAHMS — Clarinet Quintet B minor, op.115. D**
**DVORAK — Bagatelles, op.47. Members of the Berlin Philharmonic Octet. Philips stereo 6500 453.**

Brahms' Clarinet Quintet is a work I don't always care for — not even when played by Donald Westlake! It is, of course, very beautiful music and one of the very greatest of Brahms' compositions; but the quintessential Brahms, the over-Germanic romantic, simply is not for me; give me Mozart instead, any day!

Brahms was, undoubtedly, a very fine musician; he recognised the almost limitless versatility of the clarinet and wrote quite brilliantly for it. The clarinetist on this occasion, Herbert Stahr, is at the heart of my somewhat limited enthusiasm about this performance. He seems a little too much in love with the lush sounds his instrument is capable of and his indulgence tends to emphasise the rather thick scoring for the strings.

The members of the Octet play superbly well and I've no doubt Philips' engineers reproduce them faithfully. As far as I am concerned, however, the sound is too thick, plummy and almost muddy.

Luckily, these criticisms apply only to the quintet (of which, after all, there are about five other good versions available) and not to the delightful Dvorak work, which I'd not heard before, anywhere at any time.

The Bagatelles, opus 47, consist of five pieces for two violins, cello and harmonium. Yes, harmonium: the work was written for a friend who owned no other keyboard instrument! Composed in 1878, these Bagatelles are based on folk material, presumably left-overs from the first set of "Slavonic Dances" which the composer had recently finished. They are sheer joy, the blending of strings and harmonium is agreable and Dvorak's inventiveness shines forth.

If the Germanic elements in the Brahms serve to lead the players astray, they have no such problems with Dvorak and the Czech spirit does not suffer. Playing and recorded sound are quite excellent and the disc comes as yet another fine demonstration of the Berlin players' versatility and musicianship.

# What's Doing on the HiFi

Twelve months ago, there was an air of uncertainty about the hifi industry in Australia. Outside, the winds of political change were blowing and, inside, quadraphonic sound was sitting like an awkward guest. Now the mood is different — and optimistic. The public is keen to spend money on hifi gear and the industry is able to talk in positive terms about four-channel systems.

**By NEVILLE WILLIAMS**

Positive thinking about four-channel, or quadraphonic, systems is probably no better illustrated than by the line of "Technics" equipment recently announced by Haco Distributing Agencies Pty Ltd, of 57-69 Anzac Parade, Kensington, NSW. Technics is the name which has been adopted worldwide for prestige hifi products from the National / Panasonic / Matsushita stable.

Australian Sales Manager Geoff Dawes explained to EA that National / Panasonic is a big and important name but, in Japan particularly, it covers an enormous range of consumer goods, from colour television to toasters. The company felt that it needed a new brand name for its prestige hifi equipment, one which would set it apart from the mass production lines. "Technics" has a definite technical connotation and fits into most language patterns.

While a whole range of Technics hifi equipment is being released, what catches the eye and the ear are the quadraphonic systems, available at two price levels, in alternative styling, and intended for marketing through hifi dealers and selected large department stores.

At the top of the range, models SS1200D and SS2900D have most impressive specifications.

The central equipment cabinet houses a 2-speed fully automated turntable with appropriately low wow, flutter and rumble. It is fitted with a finely engineered arm and the company's well known semi-conductor cartridge, which has a rated frequency response from DC to 50kHz. Stylus pressure is 2 grams. The cartridge unerringly picks up the high frequency carrier present in CD-4 discs, and automatically activates the demodulator circuits, as indicated by a small lamp on the amplifier panel.

The amplifier itself could occupy pride of place in any hifi system.

Press tabs, a mode switch and two sliders allow it to cater for any microgroove record: mono, stereo, matrix or CD-4 discrete — the demodulator being in-built. Access is available for microphone or wireless microphone, and for tape or other auxiliary sources. There are also in-built AM and FM tuners, the latter with optional AFC.

All the usual controls are provided, operating on all four channels, while inter-channel balance is controlled by a "joystick" potentiometer.

Power output is rated at 18W RMS per channel or 72W RMS total, with all channels driven simultaneously.

The front loudspeakers, 3-way systems, can be grouped with the equipment cabinet, console style, or separated to provide greater stereo spread. The 2-way rear loudspeakers are smaller but have a similar overall tonal balance to the main units.

At a special listening session arranged for the writer, the equipment sounded very impressive indeed, particularly on imported Japanese CD-4 pressings.

While the CD-4 system can produce "surround" or 4-way "ping-pong" sound with the greatest of ease, its unique qualities become evident with traditional classical orchestral recordings. The rear channels, operating at full gain, carry only ambience with virtually no electrical cross-talk from the frontal signal. During periods of momentary quiet between musical passages, one can hear the auditorium echo diminish at its natural rate.

The system as demonstrated and pictured, is intended to sell for just under $1000, which is certainly not an excessive figure for such comprehensive equipment, fully housed in attractive cabinet work.

However, for those who find the figure somewhat daunting, the Technics model SS1000D offers much the same facilities for about $200 less. The turntable and cartridge have the same electrical specifications but fewer automatic facilities. The front loudspeakers are 2-way rather than 3-way systems and total power output is 30W RMS.

*The JVC SK-15 loudspeaker system with 15in woofer and a 55W RMS rating. The SK-12 is similarly styled but slightly smaller.*

The SS1000D is obviously designed for the enthusiast who wants a full range of facilities but for a smaller listening area.

With so ready an emphasis on the quadraphonic equipment one could easily overlook other items in the Technics range, which is claimed to be better represented in Australia than any country in the world, other than Japan itself.

On the shelves at Haco, or on the way, is a range of Technics loudspeaker systems, the new direct drive turntable already reviewed in this magazine, several two-channel stereo amplifiers and four cassette decks.

But back to the quadraphonic scene. If the Technics systems were the only ones to talk about, they could hardly be seen as establishing a strong trend. After all, Technics is a product of Matsushita, which is the parent company of Nivico, pioneers of the CD-4 system. They could be expected to do nothing less than back it with equipment and software.

In fact, Technics is only part of the emerging 4-channel scene and other equipment, at various price levels and


*The new JVC SX-3 with soft-dome tweeter and a bold styling which features the speakers. The economy 5397 is similarly styled.*

# Scene?

carrying well known names, is strongly represented. EMI Australia, for example, has a new budget priced 4-channel system which sells for about $299.

As I make this comment, Grace Bros of Broadway, one of Sydney's oldest and certainly largest department stores has almost its entire hifi display area given over to quadraphonic systems and, for the time being at least, 2-channel stereo is outnumbered on the floor.

## JVC / NIVICO

The actual pioneer of the discrete 4-channel system, JVC / Nivico, is represented in this country by Hagemeyer (Australia) B.V., also at 59 Anzac Parade, Kensington NSW 2033.

Marketing manager Gerard Volk supplied "Electronics Australia" with details of the 4-channel equipment currently available through his company, including three separate integrated 4-channel stereo receiver / amplifiers, intended primarily for shelf mounting.

All three receiver / amplifiers include inbuilt provision to decode CD-4 discrete discs, and well as the matrix circuitry necessary to handle SQ and other systems. All three incorporate an AM radio tuner with mechanical bandpass filter and an FM tuner with the detector output made available for external use. Each has a wide range of control and input facilities, as well as provision for tape connection and for remote control.

Model 4VR-5436 is the most "modest" of the units, a term which is rather inappropriate, considering its potential and specifications. Its power output rating is 17W RMS per channel into 8 ohms at 1kHz.

Model 4VR-5436 ups this to 22W per channel and has output connections for (wait for it!) two sets of quadraphonic loudspeakers. An internal circuit responds automatically to the high frequency carrier on CD-4 records and will select either CD-4 or matrix decoding without manual switching.

Model 4VR-5456 offers 31W RMS per channel (38W into 4 ohms) and still more extensive control and access facilities.

To go with the above receiver / amplifiers, Hagemeyer have two JVC / Nivico "CD-4 ready" turntables. Both are supplied with CD-4 cartridges and require only the fitting of an optimum stylus to play CD-4 discs. The SRP-87 is described as a "4-channel belt driven turntable" and the VL-8 as a "4-channel belt driven DC servomotor turntable".

If your fancy turns to 4-channel headphone listening, Hagemeyer can supply JVC / Nivico headphones with are 2-channel and 4-channel compatible. Designated as headphones type 5844, each contains two diminutive loudspeakers, positioned respectively just in front and just behind the respective ears. Frequency response is quoted at 20Hz to 20kHz and distortion level as 0.5pc at the 1mW level.

A whole range of JVC loudspeaker systems is available, each of considerable interest.

*A real style setter is this new Technics SS2900D quadraphonic system which will retail complete for just under $1,000. It will cope with all microgroove records, mono, stereo, matrix and CD-4. It has in-built AM and FM radio tuners and facilities for interconnection with external tape equipment. Total power available is 72W RMS.*

The 5397 is a compact 2-way economy system retailing at $58.50. It has a free edge 8in-woofer and 2½ in tweeter, a frequency rating of 40Hz to 20kHz and a power handling capacity 20W RMS. Its styling emphasises rather than hides the loudspeakers. The woofer radiates through a circular grille (JVC refers to it as an "acoustic lens") affixed to the face of the enclosure; the tweeter radiates through a multi-cellular horn, also affixed to the enclosure face and fully visible.

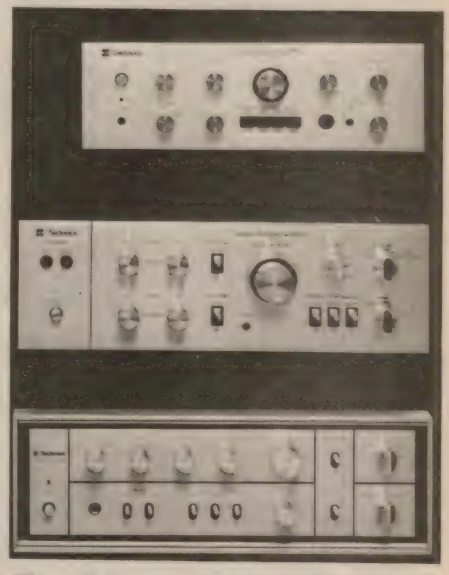
The 5399 is an column omnidirectional, rectangular system while the new SK12 and SK15 are in more conventional styling. The SK12 is a 40W RMS 6-speaker unit, with a 12in woofer and ducted reflex design. Its handsome carved wood grille can readily be removed to reveal the working faces of the transducers, and a control for high frequency balance. Frequency range is quoted as 25Hz to 22kHz, the dimensions (approx) 24 x 16 x 11 inches, and retail price $149.95.

The SK15 is along similar lines but scaled up, with a 15in woofer, slightly extended bass response, a power rating of 55W RMS and dimensions of 25 x 17 x 11 (approx) inches.

Another most interesting addition to the JVC range is the SX3 system, featuring the company's soft dome tweeter. As the term suggests, the tweeter dome is compliant, being made from treated and woven fibres. Instead of being driven as a piston, the diaphragm is sensitive to pressure changes in the air trapped behind it, so that, according to JVC, it operates as a "pulsating hemisphere" with much better than usual high frequency distribution.

Slightly larger, all round, than the compact VS-5397, the SX3 system has a 10in woofer and lays claim to a response which is virtually flat from the limits of audibility down to the bass turnover frequency of 70Hz. Below this, it has the roll-off characteristic of sealed, internally damped systems and would be assisted by some bass boost from the amplifier.

The SX3 is not a cheap system, however,



*Three 2-channel stereo amplifiers in the Technics range. The SU-3000 (top) has a rated power of 12W RMS per channel, while the SU-3400 (centre) offers 35W per channel and the SU-3600 (bottom) 50W.*

with a recommended retail price of $179, which is the same as for the big free-standing XK-15.

JCV are apparently very impressed with the soft dome principle and, as we go to press, Hagemeyer have just announced the SX-5, a deluxe 3-way system, to sell for $249.

## TEAC PROFESSIONAL

Over to the TEAC scene, the big news is the release of the TEAC / TASCAM series of professional audio equipment, intended primarily for use in recording studios, TV and radio stations and such like.

Shown to the Sydney press during August and exhibited later at the IREE Convention in Melbourne, the range is still expanding and is not yet fully represented.

# Memorex makes tape that can shatter glass.

# So what?

Sure, that proves our tape records and plays back with the precision necessary to shatter a glass.

But, you buy tape to record and play back your favourite music.

So, it's also important you know that hiss is less noticeable with Memorex. That's because we've increased high frequency response so you can decrease treble on playback.

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It's all because of the way we coat our tape.

First, we use smaller gamma ferric oxide particles. That means there are more of them on any given inch of tape. More places to pick up and play back sound.

Now anybody could come along and use smaller particles just like us; except for one thing. It's a tough job to coat small particles in a smooth, uniform manner. But Memorex does it. And, just how we do it is a little secret we can't even tell you.

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Reproduction so true it can shatter glass.

Sole Australian distributors
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LER 038

## THE HIFI SCENE

Pictured, however, is an attractive mixing console which should have a ready appeal for situations which do not demand more complex and costly units.

To back up their new mixing consoles, TEAC have the new TASCAM series-50 and series-70 professional tape recorders, which can be supplied in different configurations to accommodate quarter-inch or half-inch tape, and single, double or quadruple track.

A choice of electronics is available and the equipment can be supplied in portable form, for rack mounting, or in a trolley console, as pictured.

Prime distributor in Australia for TEAC is Australian Musical Industries Pty Ltd, whose head office is at 155 Gladstone St, South Melbourne 3205. Associated with AMI in the initial promotion of the new TEAC / TASCAM professional range is Clive Sloss, who has recently founded his own company, Syntec Electronic Distributors of 205 Deepwater Rd, Castle Cove, NSW 2069. Clive Sloss is well known in professional audio circles and, through Syntec, is planning to market a variety of equipment complementary to the TEAC / TASCAM range.

Australian Musical Industries stress, however, that their move into the professional area represents an expansion rather than a shift in marketing emphasis. They will continue to promote TEAC products to the regular domestic hifi market.

## SONAB OF SWEDEN

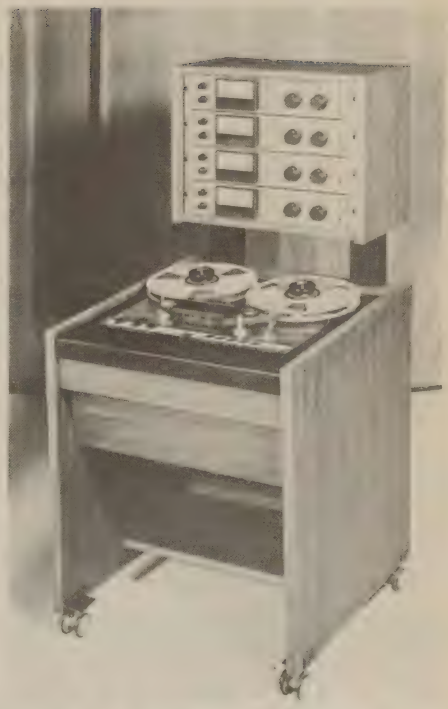
Over at 114 Walker St, North Sydney, Sonab of Sweden Pty Ltd are progressively up-dating their distinctively designed systems, which are ideally suited for the modern furnishing decor.

The loudspeaker systems — four in all — have smooth, unbroken surfaces and radiate their sound predominantly through a grille at the top. Their Swedish creator, Stig Carlsson has long maintained that sound should be radiated into the room from a 360-degree source, rather than projected towards the listener from a forward-facing loudspeaker. And to be sure, two (or four) Sonab loudspeakers can fill a room with very pleasant, non-thrusting sound.

Mating with the range of Sonab loudspeakers is the new Sonab P-4000 amplifier, again quite distinctive in appearance. The control panel is a complete departure from the "busy" look of most current amplifiers, yet it has all the essential facilities for quality home listening. Power output is a generous 50W RMS per channel into 8 ohms, or 70W per channel into 4 ohms.

Styled to harmonise with the loudspeakers and the P-4000 amplifier is the well-known 85S record player. A new player, the 55S is currently due for Australian release. Specifications for the 55S indicate a wow and flutter content of less than 0.08pc, with rumble 60dB down. The balanced arm will accept most standard cartridges but the player is normally fitted with an Ortofon F15S cartridge, with a playing weight of 1.5 grams and a response rated from 20 to 20,000Hz, plus and minus 3dB.

For personal listening, Sonab are now offering two new sets of stereo headphones, the H10 retailing at $35 and the H20 at $45. They are well finished, comfortable and capable of excellent quality sound.

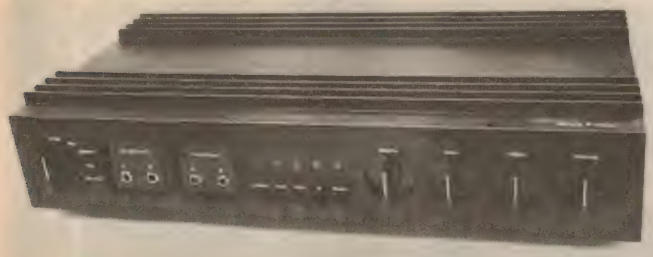


*New on the Australian market is a range of Teac equipment designed to meet professional audio situations. Pictured at left is a mixing console of modest proportions but of modern design. Tape decks can be supplied in portable, rack or trolley configurations and with a choice of track patterns and electronics.*

## ROTEL AMPLIFIERS

International Dynamics (Agencies) Pty Ltd have released three new models from the well known range of Rotel amplifiers. International's head office address, by the way, is 23 Elma Rd, North Cheltenham, Vic 3192.

Smallest of the amplifiers is the Rotel RA-211. The manufacturers, Roland Elec-



*The new Sonab P-4000 integrated amplifier with styling to match the rest of the Sonab range. Power output is ample for domestic requirements: either 50W or 70W RMS per channel, depending on load.*

*The Sonab 85S record player (bottom left) is an accepted part of the Australian scene but the 55S (below) is new and less expensive. Both players are fitted with lift-up perspex cover.*

# Select Sansui stereo amplifiers for...

## Superior design
## Superb engineering
## Sparkling performance


AU-555A

When you're considering the purchase of a complete new stereo system, the control amplifier is the key to the whole program. So it's worthy of detailed analysis.

There are six audibly superior control amplifiers in the Sansui range . . . from 30 watts RMS to 100 watts RMS. All feature *all-silicon* transistor design — and distortion is considerably *less* with Sansui control amplifiers, as output stages are semi-complementary Darlington designs without *input* or *output* transformers. Transformers have always caused some distortion problems in amplifier design — but not with Sansui!

The startling difference you will notice with any Sansui stereo amplifier is the *tonal quality* and the obvious *dynamic range*. In every price bracket your new Sansui amplifier sounds like a much more expensive unit. These are not idle words. In the review of the least expensive Sansui amplifier, the AU-101, a leading Australian journal said . . . "*. . . few amplifiers, regardless of price, give an overall test result as good as this*". Another review said . . . "*. . . better than most other amplifiers at twice the price*".

With those comments made about the AU-101 (recommended price $149) can you imagine how effective the other models in the Sansui range are? With more power and, let's face it, higher price tags?

*Let's look at the complete Sansui stereo amplifier range:*


AU-505

| MODEL | POWER RATING at 8 ohms. | FREQUENCY RESPONSE | REC. PRICE |
|---|---|---|---|
| AU-101 | 30 watts RMS | 20-60,000 Hz. ± 2 dB. | $149 |
| AU-505 | 50 watts RMS | 20-60,000 Hz. ± 2 dB. | $199 |
| AU-555A | 50 watts RMS | 20-40,000 Hz. ± 1 dB. | $237 |
| AU-666 | 70 watts RMS | 10-40,000 Hz. ± 1 dB. | $325 |
| AU-888 | 90 watts RMS | 10-70,000 Hz. ± 1 dB. | $403 |
| AU-999 | 100 watts RMS | 5-100,000 Hz. ± 1 dB. | $460 |

**IMPORTANT:** All prices are recommended prices only. The actual cost can well be less — as trade-in valuations can make a world of difference. See your Bleakley Gray franchised dealer!

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**28 Elizabeth Street, Melbourne, 3000.**
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Sansui

**Sansui Distributors: Australia, excluding W.A.:**

# Bleakley Gray Corporation Pty. Limited.

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**W.A. DISTRIBUTORS:**
Atkins Carlyle Limited, 1-9 Milligan St., Perth, 6000. Tel. 22 0191.

**Sansui equipment is manufactured by:— Sansui Electric Co. Ltd., 14-1, 2-chome, Izumi, Suginami-Ku, Tokyo, Japan.**

BG—SA—1272

tronics Co Ltd, are very specific in rating the amplifier, giving four levels of power output. The lowest figure is 10W per channel into 8 ohms, with both channels driven; the highest is 16W per channel into 4 ohms with one channel driven. These figures are for less than 1pc THD at 1kHz; presumably the power output at clipping point would be higher.

The performance specifications are all excellent and the amplifier has a full range of control facilities. It would obviously be an attractive proposition for the average domestic situation, assuming loudspeaker systems of reasonable acoustic efficiency.

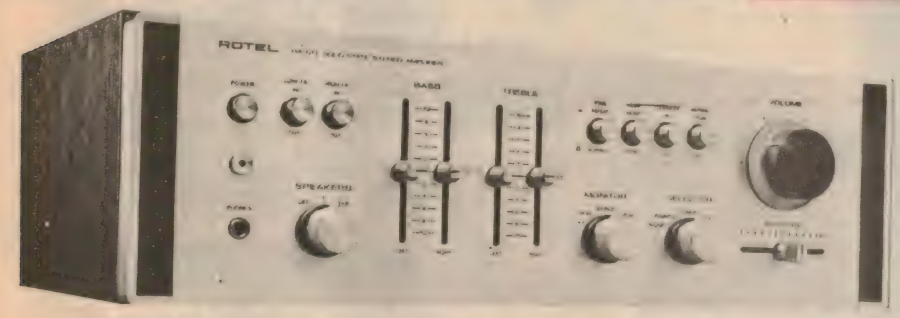
For those requiring somewhat higher power, the Rotel 311 offers approximately double the output, with figures ranging from 20 to 30 watts RMS per channel, again measured for less than 1.0pc THD. The remaining specifications are similar to the 211, in some cases marginally better.

The styling is also very similar but the 311 has provision for loudspeaker matrixing to provide simulated quadraphonic. An additional panel control selects the loudspeaker mode.

But the "big noise" in the range is the Rotel 611 with power ratings between 30 and 42 watts RMS per channel, depending on impedance, the figures being taken at a mere 0.5pc THD. Response is quoted as within 3dB from 5Hz to 100kHz, power bandwidth from 5Hz to 55kHz, and total harmonic distortion as less than 0.1pc measured at 27W RMS into 8 ohms.

The 611 has an extensive range of controls and input facilities and is designed for use with auxiliary tape equipment.

International Dynamics commissioned local tests on the amplifiers, which supported the manufacturer's claims in respect to quality, design and performance. International's manager, David Marshall, was obviously keyed up about the new Rotel range, when he told EA about them shortly after receiving the local test results.




*Below: The Rotel RA-611 integrated amplifier, as described below. It has a full range of control and external access facilities and will deliver 42W RMS per channel into 4 ohms. Other amplifiers in the range employ the same general styling but have somewhat fewer facilities and less power output.*

*Right: A group of turntables from Ralmar Agencies. At the back is the economy model BMU 121, while the more elaborate BRU 121 is at the front. On the right is the fully automatic BFU 121. A magnetic headshell is normally fitted.*

## RALMAR AGENCIES

At Ralmar Agencies (431 Kent St, Sydney 2000) the current emphasis is on turntables and cartridges.

Representing what must be about the ultimate in economy for a quality system player, their BMU 121 unit retails for $69.95. For this price, the buyer gets a player with 12 in diecast aluminium turntable, 2-speed belt driven, an S-shaped arm with standard plug-in headshell, anti-skating, cueing and adjustable counterbalance. A magnetic cartridge is fitted, carrying a diamond stylus. The enthusiast can arrange his own plinth, or purchase one from Ralmar at $21.75 for the standard unit and $25.00 for the deluxe

For $79.95, the BRU 121 player has a more elaborate arm automatic cut-off at the end of play, while the BFU 121 has full automatic play facilities. Plinths are a separate item, as for the BMU 121.

Spare headshells are available, along with a range of "Jelco" magnetic cartridges. These range in price from $12.50 for the MC.15 to $21 for the MC12E, which Jelco claim to be suitable for all quadraphonic records, including CD-4.

And, if space is a problem, but you still want a quadraphonic system, Ralmar may be able to help in another way. Two flat "panel" loudspeakers have just made their appearance on the showroom floor, the PS3 for $26.95 and the PS5 for $35.25.

*In the pipeline from the AIWA Co Ltd of Tokyo is this TPR-4001 8-track cartridge player, complete with AM and FM radio tuners and facilities to copy directly off air. It has an in-built time switch and can be programmed to play, or repeat particular tracks. (Goldring Engineering A'Asia Pty Ltd.)*

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The critiques from these hobbyist magazines have unusual merit as these publications accept no advertising. Their comparative evaluations are funded solely by the subscriptions of ardent audiophiles.

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# VARIETY FARE

REVIEWS OF OTHER RECORDINGS

## Devotional Records

**IN THE SWEET BY AND BY. Roy and Dale, with orchestra arranged and conducted by Kurt Kaiser. Stereo, Word WST 8589-LP. (From Sacred Productions Aust, 181 Clarence St, Sydney and other capitals.)**

Roy Rogers and Dale Evans are well known in the entertainment world of films and television. To practicing Christians they are of note because of their long association with the evangelical movement in Hollywood, and with Billy Graham crusades. There is therefore a personal quality about this album which will commend it to many.

On the basis of its musical content alone, the album is average only. Dale Evans sings with a very pronounced vibrato which will worry some, and which certainly does nothing for the harmony in the duets. The titles:

In The Sweet By And By — Jesus In The Morning — If I Can Help Somebody — I'll Fly Away — Peace In The Valley — On The Wings Of A Snow White Dove — The Cowboy's Prayer — Softly And Tenderly — This Little Light Of Mine — Whispering Hope and Star Of Hope.

Not an outstanding record but adequate as a memento of two well-known and sincere Christians from the entertainment capital. (W.N.W.)

★ ★ ★

**HANDEL. Highlights of Messiah. English Chamber Orchestra, with the Amor Artis Chorale. Vanguard stereo VCS 10100 (Quadraphonic VSQ 30002.)**

"Highlights of Messiah" is a collection of excerpts from recent full recording of Messiah done by the English Chamber Orchestra under the direction of Johannes Somary. Presumably, the tracks have been chosen to show the three-record set (Vanguard VCS-10090,1,2) to best advantage and the sleeve notes indicate that it has been favourably received by overseas reviewers. For my part, I have heard more satisfying performances on other albums, although the recording standard here would be hard to beat.

As an example of my reaction, I found the Bass singer, Justino Diaz, shallow and even pompous rather than commanding in "Why Do The Nations So Furiously Rage Together." In fact it would be fair to sum up the disc by stating that the singers could put a lot more into their singing. Maybe I am a little unfair and the buyer should listen for himself.

Listing some of the twelve excerpts: Comfort Ye My People — Every Valley Shall Be Exalted — All We Like Sheep Have Gone Astray — I Know That My Redeemer Liveth. (L.D.S.)

★ ★ ★

**JESUS IS COMING. By John Peterson. Stereo, Singcord ZLP-859S. (From John Bacon Publishing Co Pty Ltd, 119 Burwood Rd, Burwood, Vic 3125).**

When I set about to review this new disc from the team of John Peterson and Don Wyrtzen, I rather expected the full youth "Saturday evening" approach. But no — and very pleasantly for this reviewer — the sound that greeted me was derived more from the traditional oratorio or cantata format: orchestra, chorus, soloists, and words drawn directly from the Biblical text.

The track titles trace the coming of Christ to Bethlehem, his ministry, ascension and promised return: Jesus Is Coming — Let Not Your Heart Be Troubled — Events Of The Ascension — Looking For Jesus — In The Last Days — Will You Be Ready? — The Blessed Hope — Chariot Of Clouds — Like Him — And I Saw Heaven Opened — King Of Kings — With The Sound Of Trumpets.

Lest my earlier reference to an oratorio has left the impression that this composition is traditional, stuffy and dull, let me hasten to assure you that just the reverse is true. It is a very tuneful and adept combination of the traditional approach with modern harmony and rhythm. The performance itself is excellent, as also is the diction, and the recording very clean. It sounded fine when played through a four-channel system.

I would strongly recommend this as one of the best devotional records I have heard in quite a long time. (W.N.W.)

Editorial Note: Readers' attention is drawn to two reviews by Paul Frolich in the "Classical Recordings" on the preceding pages. One is: Haydn — The Seven Last Words — DGG stereo 2530-213. The other: Bach — Cantatas No 74 and 147 — Philips stereo 6500-386.

## Instrumental, Vocal and Humour

**THE STRAUSS FAMILY. Music for the TV series, recorded by the London Symphony Orchestra, conducted by Cyril Ornadel. Stereo, Polydor 2668 012, two disc set in folding sleeve.**

Apparently the ATV television program company in the UK has made a series dealing with the lives of various members of the Strauss family. So far, none of the episodes has been seen in Australia, but the music recorded for the series certainly has, and to prove it, here it is.

The two discs are beautifully packaged in a glossy folding sleeve in full colour, and the music has been very well recorded by the Polydor company. However, the performance leaves much to be desired. Compared with the brilliant, sparkling performances one becomes accustomed to hear from the Viennese orchestras, particularly when conducted by Willi Boskowsky, these tracks sound flat and uninteresting. This is a pity since there is some very fine music included in the selection: Radetsky March — Einzug Gallop — Ball Racketen Waltz — Lorelei Rhein Klange — Tabuerl'n Waltz — Maskenleider Waltz — Debut Quadrille — Annen Polka — Pizzicato Polka — Moulinet Polka — Bahn Frei — Thunder and Lightning Polka — Overture "Die Fledermaus" — Morning Papers Waltz — Vienna Blood Waltz — Blue Danube Waltz — Overture "Gipsy Baron" — Tales of the Vienna Woods — Tritsch Tratsch Polka — Emperor Waltz — Perpetuum Mobile.

Not a set I can recommend to Strauss enthusiasts, I am afraid, but quite useful as background music of the light classical kind. (H.A.T.)

★ ★ ★

**THE NUTCRACKER — Tchaikowsky. Complete Ballet: The London Symphony Orchestra, conducted by Andre Previn, Stereo, His Master's Voice SLS-834. Two disc set in folding sleeve.**

The suite arranged by Tchaikowsky from his "Nutcracker" ballet music has been recorded ad nauseam, but there have been few recordings of the complete ballet. No doubt this is because (1) most of the best melodies are to be found in the suite, and (2) most people find nearly two hours of ballet music a bit over-much without the visual attractions of stage performance.

However, there is a great deal of attractive music in the full score which is not included in the "Nutcracker Suite," including the famous Pas de Deux melody based on the descending scale, which is at least equal in musical interest to anything in the Suite.

Andre Previn, who conducts the London Symphony in this performance, has now apparently successfully discarded his previous Hollywood and jazz associations, and may now be regarded as an established classical conductor. Despite his youth, Previn's musical is entirely traditional. At any rate, he seems disinclined to innovation or any departure from the accepted view of this music. Thus, you need not hesitate to buy this set from a fear that the performance suffers from the interpretational quirks of a young man.

The Phase Four recording is hi-fi in every sense. (H.A.T.)

**Reviews in this section are by Neville Williams (W.N.W), Harry Tyrer (H.A.T.), Leo Simpson (L.D.S.), Gil Wahlquist (G.W.), and Norman Marks (N.J.M.).**

## VARIETY FARE

**CHOPIN. Piano music played by Ivan Davis. Phase 4 Stereo concert Series. PFS 4262.**

Apparently I was one of very few reviewers who did not favour Ivan Davis's recording of the Rachmaninov second Piano Concerto — although I subsequently noticed it was not included in the "Gramophone's" list of the best recordings of the work. Now I can find very little to like in this recital of popular Chopin works. It seems to me to lack that undefinable quality which, for want of a better word, I must call "soul." In other words, it seems to me to be a dead pan performance, technically first class, but lacking in poetry.

The very well known items played are: Fantaisie Impromptu — Etude in E, Op 10, No 3 — Valse in C sharp minor, Op 64, No 2 — Barcarolle — Ballade No 1 in G minor — Nocturne in D flat, Op 27, No 2 — Valse in D flat (Minute), Op 64, No 1 — Scherzo No 3 in C sharp minor.

If this program has special attractions for you, and your taste is for depersonalised Chopin, ask your dealer to let you hear a track or two. You will certainly not be disappointed with the recording quality, which leaves nothing to be desired. (H.A.T.)

★ ★ ★

**A RUSSIAN FESTIVAL GALA. The Orchestre de Paris, conducted by Gennady Rozhdestvensky. Studio 2 Stereo TWO 395.**

One of Russia's leading conductors teams up here with France's premier orchestra to present this sparkling performance of four of the most popular items in the repertoire of Russian short orchestral pieces: Polovtsian Dances — Capriccio Espagnole — Russian Easter Festival Overture — A Night on the Bare Mountain. The Paris musicians do not always play well for guest conductors, but they give of their best for the Russian visitor here. A slight drawback for me was the arrangement of the Polovtsian Dances, which here have the beautiful melody of the "Dance of the Young Maidens" in second position, instead of opening the piece. However correct this may be in terms of respective positions in the original score, most conductors open the work with the slow piece, and to my mind this gives the whole a much better balance. However the disappointment of this was more than compensated for by the lively performance of "Capriccio Espagnole" which followed. The Studio 2 Stereo recording is excellent. (H.A.T.)

★ ★ ★

**THE ADELAIDE WIND QUINTET plays works by Tchaikowsky, Wagner, Bizet and Moussorgsky. Stereo, His Master's Voice OASD 7570.**

This quintet consists of David Cubbins, flute; Jiri Tancibudek, oboe: Gabor Reeves, clarinet; Thomas Wightman, bassoon; Patrick Brisian. Perhaps because the repertoire for their combination is limited, they here play arrangements by Dr William Lovelock of some well-known lighter classics: Overture, Dance of the Flutes, Chinese Dance, Trepak, from "Nutcracker Suite" (Tchaikowsky) — Siegfried Idyll (Wagner) — Minuetto, Adagietto, Carillon, from "L'Arlesienne" (Bizet) — Excerpts from "Pictures at an Exhibition" (Moussorgsky).

No doubt this program is intended to appeal to a wider audience than any of the standard chamber works for wind quintet, but I doubt whether it will. Despite the obvious skill of the performers, the music in this unfamiliar style sounds stuffy, and the Wagner piece, which drags on for no less than 19 minutes, is excruciatingly dull.

On the credit side, the recording engineer deserves praise for a first class effort. The clarity of the recording and the stereo spread can compare with the best overseas recordings. (H.A.T.)

★ ★ ★

**STARS OF THE OLD VIC AND SADLERS WELLS. Mono, His Master's Voice, RLS 707, three record boxed set.**

Historical recordings of this sort tend to be of interest mainly to those with nostalgic memories of the artists and occasions involved, through having attended performances during the period.

Thus, one could expect music loving Londoners who attended concerts and opera performances during the years between the two world wars to buy this set, as they would almost certainly have been to the Old Vic and / or Sadlers Wells performances. Also, they would be appreciative of the wonderful service Lilian Bayliss performed for impecunious music lovers by staging operas in English, at very low prices, for over 40 years, until her death in

1937, triumphing over almost insuperable financial difficulties, aggravated by government indifference.

Despite this she managed to stage performances of a very high standard, as can be judged by the recordings included in this selection. Indeed, the continuing interest of EMI which gave rise to these performances is in itself a tribute to the work of the two opera companies.

Her artists (and guest artists, of which there were many, including the great Melba) represented here include some still very well-known names, such as John Heddle Nash, Edith Coates, Tudor Davis, Maggie Teyte, Joan Hammond, Owen Brannigan, Joan Cross, Redvers Llewellyn, Parry Jones, Gwen Catley, Florence Austral, Peter Pears, Victoria Sladen, Charles Craig . . . all these, and many more are presented in this selection.

The works in which they appear include: Rigoletto — La Boheme — carmen — Tosca — Jeanne dArc — Lohengrin — Marriage of Figaro — Faust — Bartered Bride — Falstaff — I Pagliacci — Magic Flute — Cavalleria Rusticana — Peter Grimes (the first performance of which was staged at Sadlers Wells) — Simone Boccangra — Die Fledermaus.

The recordings were mostly made during the 78 rpm period, when recording activity was mainly restricted to the most popular arias and choruses, so the titles here will be very familiar fare to opera lovers. The sound quality is what one would expect, bearing in mind that the earliest recordings date from the pre-electric recording days and the most modern in the early LP period. (H.A.T.)

★ ★ ★

**GOLDEN OPERETTA FAVOURITES. Various artists and orchestras. Studio 2 Stereo, TWO 384.**

It seems hardly necessary to do more than list the artists and titles in a disc of this sort, but with 14 tracks and numerous names to contend with, to give the complete list in sequence would be too space consuming. The titles include: Komm die Gondel (A Night in Venice) — Schenkt Sich Mann Rosen in Tirol (The Faithful Peasant) — So Elend and Treu (Gipsy Baron) — Stets Kommt Mir Wieder in Den Sinn (The Queen's Lace Handkerchief) — O Madchen, Mein Madchen (Frederika) — Da Draussen im Durftenden Garten (A Waltz Dream) — Mein Liebeslied muss ein Waltzer Sein (White Horse Inn). The artists include such established performers as Nicolai Gedda, Annaliese Rothenberger, Erika Koth, Brigette Fassbaender, Rita Streich, Lucia Popp, Hermann Prey and Grace Bumbry.

With such an imposing list of names and popular titles, those with a taste for operetta cannot fail to be delighted. However, one can only wonder why there are no titles from what are universally regarded as the two best operettas ever written — "Die Fledermaus" and "The Merry Widow."

If you can overlook this shortcoming, buy with confidence. In every other respect, the disc is first class — technically as well as the high standard of singing throughout. (H.A.T.)

★ ★ ★

**HAMMOND SPECTACULAR. Claude Papesch playing the Hammond B3 organ, with orchestra. Stereo, Columbia series 299 SOEX 10021.**

Claude Papesch, who plays regularly at Sydney's "Top Of The Cross" Travelodge restaurant is backed here by drums, bass, guitar, trumpet, trombone, saxes and percussion, wielded by players who are rightfully acknowledged on the jacket. Recorded in the Sydney EMI studios, the group produces a pleasant and predominantly easy-on-the-ear sound, which you can play at feature level or as background.

The generous program of 14 tracks includes: My Way — A Man And A Woman — Fire And Rain — My Cherie Amour — Rocket Man — For All We Know — Lucretia Macevil — Clair — LA International and Gentle On My Mind — This Guy's In Love With You — For Once In My Life — Love Is Blue — Spanish Harlem — In The Summertime and Seaside Shuffle.

The quality is good and the stereo spread normal. Perhaps I should mention that, while the organ plays a vital role, it is used more as part of the orchestra, than as a solo instrument. Good value if the music appeals. (W.N.W.)

★ ★ ★

**DEUTSCHE ARMEEMARSCHE. German and Austrian Marches. Europa stereo E 387.**

If martial music is your cup of tea, you'll find yourself developing a new taste. These German and Austrian army marches are quite unlike anything served up by Sousa. Some of the Austrian marches can only be described as elegant — charming in fact. They have a wide variety of instrumentation which "gives the

## VARIETY FARE

music an impression of freshness and newness" to quote the jacket notes. Recording quality is outstanding. Highly enjoyable. (L.D.S.)

★ ★ ★

**THE SIX GREAT POLONAISES — Chopin Milosz Magin, piano Stereo, Decca SXLA 7516.**

Here is a splendidly vigorous account of the six "great" polonaises of Chopin's maturity. Milosz Magin, who is a Pole resident in France, plays with fire and assured conviction. On the evidence of this performance, he must be regarded as a fully mature artist, and why more of his recordings have not been seen in Australia is a matter for speculation. If you want to sample before buying, try Polonaise No. 5 in F sharp minor — a masterly performance.

Apart from what appears to be a clumsy piece of control panel work at the beginning of side 2, the recording is technically A1 (H.A.T.)

★ ★ ★

**J. S. BACH — orchestral works. The Munich Bach Orchestra, conducted by Karl Richter. Stereo, Archive 2565 010.**

There are no finer exponents of Bach orchestral works than the Munich Bach Orchestra under their conductor Karl Richter. These performances of the Brandenburg Concerto No 2 in F major, the Concerto for two harpsichords, strings and continuo, and the Orchestral Suite No 1 in C, would be worth every cent of a $6 disc, but it has been made available at the special price of $3.98, to commemorate the 25th year of recording by the Archive branch of the D.G.G. company. No doubt it is also intended to foster new interest in the company's Archive catalogue as well.

With the recording resources of the great D.G.G. organisation available to them, Archive have been renowned for the quality of their recordings, and one is therefore not surprised at the near perfection of the sound in this recording. Unfortunately some surface "prickle" was present in some tracks, but this may be confined to a single batch from which my sample pressing was taken. The disc comes in a lavishly produced folding sleeve with catalogue insert printed in full colour. It is a bargain that Bach lovers will not want to miss. (H.A.T.)

★ ★ ★

**INNER SPACE, Composed and conducted by Sven Libaek Festival FL 34855.**

This is the sound track for the television series made by those skilled underwater photographers, Ron and Val Taylor. — Like most theme music, it is a little hard to classify. My nearest description would be cool jazz and, as such, most of the tracks make good listening, with titles such as "Music For Eels", "Sounds Of The Deep", "Danger Reef" and other such aquatic names. My only quarrel with the quality is the too close 'miking' of some of the instruments, notably woodwinds, creating a somewhat 'breathy' sound. Apart from this it makes an unusual addition to available program style of records and as such is worth an audition. (N.J.M.)

# "WORLD OF THE GREAT CLASSICS" — DECCA

Further additions to the Decca "World of the Great Classics" series, priced at $2.99, provide more opportunities for bargain hunting by budget classic collectors.

**TCHAIKOWSKY — Violin Concerto (and Violin Concerto No. 1 by Paganini, arranged Kreisler). Campoli, violin, and the London Symphony Orchestra, conducted by Ataulfa Argenta (and Pierino Gamba), Stereo, SPA 183.**

Campoli (born Alfred Camp, I believe) was a popular concert violinist in post-war London, having graduated from the realms of lighter music. His success was well deserved, as in addition to a very sound technique, he demonstrates here the ability to produce a mellow yet full bodied tone, and a tendency to emphasise the soulful elements in the music. This is particularly noticeable in the Paganini work, with its highly perfumed melodies, where Campoli positively wallows in romanticism. I think most people will agree with his approach. The dated sound wears well. (H.A.T.)

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**CHARGE. Enoch Light and the Light Brigade Project 3 Stereo PJL 34828 Festival release.**

Enoch Light pulls all his recording tricks out of the bag in this collection of hits. The sound quality, as we have come to expect from this man and his team, is superb but the arrangements can be summed up by one of the tracks, "What Have They Done To My Song, Ma." I found myself checking the titles on the sleeve to be sure of some of the numbers. This aside, the record can well demonstrate modern recording skills to advantage on such titles as: Fire And Rain — Spinning Wheel — Bridge Over Troubled Waters — Hard Day's Night — Sweet Caroline — Amazing Grace — Lonely Days. (N.J.M.)

★ ★ ★

**ALONG MEXICAN HIGHWAYS. Roberto Delgado and his orchestra. Karussel stereo 2430 074.**

"Lively Latin-American arrangements with plenty of percussion" aptly describes this album. At the price of $2.75 it is good value. Stereo spread is wide and even and sound quality is okay. Surface moise was low.

Twelve tracks are featured: Mexico — Tequila — Island In The Sun — Amapola — Pata Pata — Cielito Lindo — La Bamba — Cayenne Pepper — Maria Elena — Guantanamera — Trip To Nicaragua — El Jarabe Tapation. (L.D.S.)

★ ★ ★

**AKKORDION 3 DIMENSIONAL. Harry Mooten Trio. Europa stereo E 448.**

In reasonably small doses, this album makes a pleasant background for dining or driving, if you have the cassette release (CE 448). Side one is more listenable than side two. Record quality is good.

The tracks are in medley form, some as follows: The Yellow Rose of Texas — Down By The Riverside — Turkey In The Straw — O Happy Day — Tango Mephisto — El Condor Pasa. (L.D.S.)

**CAPRICCIO ESPAGNOLE. Various orchestras and conductors. Stereo SPA 182.**

There are four items of "Spanish" music here, and not one by a Spaniard. However, they are all extremely tuneful and popular and three of them at least are regularly recorded. These are: Rimsky Korsakoff's orchestral showpiece "Capriccio Espagnol" recorded here in fine style by the London Symphony and Jean Martinon; Glinka's Spanish Overture "Jota Aragonesa" played here with vigour if not too much finesse by the Suisse Romande orchestra under Ernest Ansermet; and Ravel's masterly creation "Rapsodie Espagnole" played by the erstwhile Paris Conservatoire Orchestra under Jean Morel — a pleasing performance.

Not so often heard nowadays, although very popular salon pieces in their orginal piano versions at one time, are Moszkowski's Spanish Dances, the first five of which are played here in orchestral version by the London Symphony Orchestra under Ataulfo Argenta — lively and tuneful music but only superficially Spanish. (H.A.T.)

★ ★ ★

**TCHAIKOWSKY — Symphony No. 5. Paris Conservatoire Orchestra, conducted by Georg Solti. Stereo, SPA 223.**

**TCHAIKOWSKY — Symphony No. 6 "Pathetique". L'Orchestre de la Suisse Romande, conducted by Ernest Ansermet. Stereo SPA 221.**

These two are deservedly Tchaikowsky's most popular symphonies, and their release almost simultaneously on this low cost label will be welcomed by many still wanting them for their collections.

However, if you want only one at the present time, I would recommend the Fifth in preference to the Sixth. Not that the Swiss players under Ansermet give anything like a bad performance of the Sixth. It is the overall superiority of the Frenchmen under Solti, their musicianship, their ability to give a phrase a more subtle shade of meaning, which gains for them my vote. In addition, the sound quality of the Fifth recording is superior, and I imagine it is a much later recording than that of the Fifth. Tape hiss is virtually un-noticeable in this recording. This is certainly not the case in the other recordings, where tape noise is present. (H.A.T.).

★ ★ ★

**RECOMMENDED:**

**THE WORLD OF RUSSIA. Night on the Bare Mountain (Moussorgsky) — Overture to Prince Igor (Borodin) — Overture to Russian and Ludmilla (Glinka) — Introduction and Persian Dance from "Khovantschina" (Moussorgsky). The Berlin Philharmonic Orchestra, conducted by George Solti. Stereo SPA 257.**

**ALSO RECEIVED:**

**SAINT-SAENS — Symphony No. 3; L'Orchestre de la Suisse Romande, conducted by Ernest Ansermet. Le Rouette d'Omphale; Paris Conservatoire Orchestra, conducted by Jean Martinon. Stereo SPA 228.**

## VARIETY FARE

**JOHN KEATING'S SPACE EXPERIMENT. Studio 2, SQ quadraphonic, Columbia 04 TWO. 393.**

On the front of the jacket is a most impressive full colour shot of an orbiting spacecraft, with an astronaut working in the open hatch. The music, featuring the EMS Synthi VCS3 music synthesiser, is real science fiction stuff, a mixture of piano, reeds, electronics and sound effects:

I Feel The Earth Move — The Unknown Planet — Rocket Man — Prelude To Earth Rise — Star Trek — Space Agent — Jesus Christ Superstar — Upon Another Earth — The Sound Of Silence — Signal To Saturn.

If you like science fiction music, or you want a different kind of sound, then John Keating's space "experience" may suit you but I doubt that you'll like it otherwise. I did not find the quadraphonic effects all that spacious but I expect that they would emerge to much better advantage with the aid of a full logic system. (W.N.W.)

★ ★ ★

**BIG HITS OF THE 20's. Enoch Light & The Light Brigade. Quadraphonic, Project 3, PR-5059SD (see below).**

Without back-tracking, I'm not sure of the history of this recording. The jacket has a very familiar look and, over and above the number quoted above, there are two others on the jacket and label: PJL-34467 and QMX-39721/2. I would assume that the latter indicates that this is a new quadraphonic mix-down from the original recordings on magnetic film.

But whatever its background, it's really a beauty. I don't think I've ever heard better separation from a simple system, particularly front/back. It has to be good when a male soloist from the front is answered by a female soloist from the rear, leading into a duet from opposite ends of the room.

The music itself is drawn from the timeless tunes of the 20's, played in the style of the day but recorded to a standard that leaves nothing to be desired. And who couldn't respond to these chestnuts: Happy Days Are Here Again — Chicago — If You Knew Susie — Sometimes I'm Happy — Tea For Two — That's My Baby — Charleston — Four Leaf Clover — Somebody Loves Me — Bye, Bye Blackbird — Ain't She Sweet — Toot, Toot, Tootsie.

If you own a quadraphonic system, make yourself a present of this one. (W.N.W.)

★ ★ ★

**TRY TO REMEMBER, with Victor Silvester and his Orchestra Astor Stereo SPLP 1414.**

Mister Strict Tempo Silvester seems to have an inexhaustable supply of dance themes to record and this disc certainly upholds his reputation for quality dance music for a party or just listening. Each title on the sleeve is coupled with the tempo in which it has been played, making selection easy from the fourteen tracks which include: You Only Live Twice — Godfather Love Theme — Didn't We — Lollipops And Roses — Santa Catarina — Misty — Try To Remember — Canadian Capers — Chopin's Nocturne — Dream. The recording quality is good and the record would be a welcome inclusion in the collection of any dance music enthusiast. (N.J.M.)

★ ★ ★

**TOP BRASS. Peter Lane Big Band. Stereo, Troubadour TCS-036. (From Troubadour Records Pty Ltd, PO Box 41, Balmain, 2041).**

This is the two-channel version of the album which formed the basis of our article last month "Background to a Quadraphonic Recording." As you will have gathered, it has been a pet project of producer Malcolm Abel, to the extent that it is being released in seven different forms: 2-channel and 4-channel disc, 2-channel cassette, and 2-channel and 4-channel cartridge and open reel. As such, it may provide a unique series of recordings for A-B demonstrations of the various media.

Technically, it would be equal to such demands. The sound is round, clean and free from any suggestion of background hiss and, being a big band album, it offers a wide range of orchestral sound — all of it very well executed.

As to the music, it's a typical big band sound, which is meant to be heard, not attenuated into the general background.

The titles of the generous program are: Rock Around The Clock — Swinging Cymbals — Theme From "Princess Gun" — In A Sentimental Mood — Il Crescendo — Drum Drone — Don't Sleep In The Subway — Hard Day's Night — South Rampart Street Parade — Taste Of Honey — Splanky — Keep Movin' — Look Of Love — Super Star.

If you like the big band sound, you'll certainly like this one. (W.N.W.)

★ ★ ★

**LOVE AND DANCE AROUND THE WORLD. Peter Ross and his Big Band Dance Orchestra. Stereo Concert Hall SVS-2714. (Concert Hall Record Club, 130 Parramatta Rd, Ashfield 2131.)**

While adhering to the broad concept of providing dance music, Peter Ross manages very well to avoid the monotony of uniform tempos and orchestration, even introducing a chorus and touches of singalong. So you can dance or you can simply sit and listen.

The tunes: Cielito Lindo — Candlelight Waltz — Vaya Con Dios — La Felicidad — Fascination — Wohon Du Gehst — Granada — Guantanamera — The Last Waltz — Strangers In The Night — Valencia — Adios.

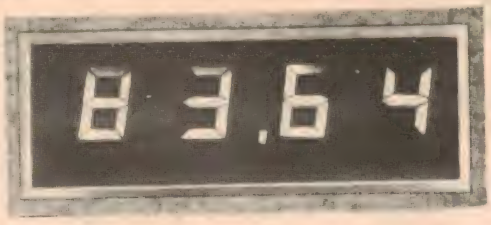
Following their usual custom, Concert Hall brand this "synchro stereo" emphasising its mono/stereo compatibility; just to be different, I played it as simulated quad and it sounded clean and well balanced.

Incidentally, if you should prefer Bossa Nova, Concert Hall offer a companion album by that name as SPS-1320. (W.N.W.)

★ ★ ★

**FILM THEMES. Alfred Hause and his Orchestra. Stereo, Polydor 2371307.**

Alfred Hause, one of West Germany's most popular conductors of music in the relaxing style of Frank Pourcel, Lawrence Welk and similar band leaders, has now established an international reputation. If you pay attention to names when announced on radio, you will probably have heard him mentioned, as his recordings are often

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## VARIETY FARE

played on air. He is a first-class arranger, and his band of German musicians play with sophisticated elegance.

The selection here comprises: Charade — 13 Jours en France — Raindrops Keep Falling on my Head — Sinno Me Moro — A Time for Us — Theme from "Shaft" — Lara's Theme — Jeud Interdits — Anonimo Veneziano — Tonight, from "West Side Story" — Both Sides Now — The Great Escape March. Fine tunes, every one, and excellently recorded by Polydor. (H.A.T.)

★ ★ ★

**THE NEW SEEKERS LIVE AT THE ROYAL ALBERT HALL. Philips stereo 6641 065. 2-record set.**

Live performances on record can all too easily be a drag. But what makes this record particularly enjoyable is the feedback from the audience. In fact, without the interplay between audience and performers, the line-up of twenty-odd songs would just not "hang together." The New Seekers certainly have great empathy with their audience.

Recording quality is surprisingly good and stereo spread is very wide. Definitely worth having a listen to, if you're a New Seekers fan.

Some of the tracks are as follows: Ticket To Ride — Nickel Song — Never Ending Song — When I Was Small — Good Old Fashioned Music — Beg, Steal Or Borrow — I'd Like To Teach The World To Sing — Angel of the Morning. (L.D.S.)

★ ★ ★

**LUCILLE STARR, The French Song. A & M Records Stereo AML-31,507 Festival Release.**

This Candian girl has a most appealing voice and makes the most of it in a bilingual presentation of a dozen favourites, backed by an unobtrusive vocal group and orchestra. The Titles are: The French Song — Dominique — La Vie En Rose — In a little Spanish Town — Colinda — Crazy arms — Sukiyaki — Wooden Heart — Release Me — Jolie Jacqueline — Yours — My Man.

The recording quality is good. I hope we hear more of this singer. (N.J.M.)

★ ★ ★

**A SONG FOR SCOTLAND. Various artists. Stereo, Columbia series 299 SOEX-9706.**

For anyone who has enjoyed the hospitality of Edinburgh, the picture of the castle on the jacket may well lure you to reach for the purchase price of this budget album. For your money you will also get a dozen tracks, which will be variously familiar according to your ancestry:

Scotland The Brave — The Royal Mile — Bonnie Earl O'Moray — Mormand Braes — Westering Home — These Are My Mountains — The Peat Fire Flame — Back O' Bennachee — Song Of The Clyde — My Love Is Like A Red, Red Rose — The Road To The Isles — Auld Lang Syne.

The soloists, male and female, are well up to standard but the recording does not do them all equal justice. One or two of the tracks are obviously old material, the rest ranging through to good. There is not race of surface noise, however, and if you like the material, you'll forgive its occasional shortcomings. (W.N.W.)

★ ★ ★

**THE CALIFORNIA POPPY PICKERS play and sing Hair, Aquarius and others. QS quadraphonic, Astor Gold QS-9.**

A few months ago, I would have listened with interest to any quadraphonic disc but that no longer applies. Modern technology is always an asset but it isn't a substitute for enjoyable material. As you've probably guessed, I didn't go much on this combination of the folk style Poppy Pickers and the songs as under:'

Yellow Submarine — Back In The USSR — Aquarius — Sunshine Summer Days — Hungry Eyes — Hair — Clean Up Your Own Back Yard — Narrow People — It's Written All Over My Face — Games People Play.

If you know the group and like the songs, then by all means get your money out. The quadraphonic technology will put a few more poppy pickers in your room! (W.N.W.)

★ ★ ★

**THE BEST OF THE IRISH ROVERS. MCA stereo 6372.**

If you don't like the Irish Rovers well you can at least buy this album for your kids. It's all good fun and they may as well enjoy it before they "graduate" to teenybopper singers which seem to be proliferating. Sound quality varies from average to frankly poor but that is probably not important to most of the people it will appeal to.

Ten tracks are featured: The Unicorn — The Biplane — The Orange And The Green — Penny Whistle Peddler — Lily The Pink — Rhymes And Reasons — Years May Come, Years May Go — Whiskey On A Sunday — Black Velvet Band — Goodbye Mrs Durkin. (L.D.S.)

★ ★ ★

**CHER. Volume 2. Cher Bono. United Artists stereo UAL 271 / 2. 2-record set $7.95.**

If you are a fan of Cher Bono's because of songs like "Beat Of A Different Drum" then you can forget this 2-record set. Cher tries to sing the sentimental stuff and it's just not her bag. It's flat — like the record. She should stick to her original drummer.

Some of the tracks are: I Will Wait For You — Come To Your Window — Twelfth Of Never — It's Not Unusual — Take Me For A Little While. (L.D.S.)

★ ★ ★

**STEAM ENGINES, THE LAST CHAPTER. Astor GGS Stereo 1363.**

It is probably lucky for my neighbours, as well as myself, that we live within earshot of a main railway line that carries most of the Northern freight out of Sydney, particularly at night. Otherwise my playing of this incredibly realistic record would have caused something of a stir. The record is a sound portrait of a number of industrial locomotives around Aryshire, Cumberland, Durham, Northumberland, Surrey, and Warwickshire in the UK. The sound quality and the effective stereo so conjures up the atmosphere of the railway yard I almost felt covered in coal dust and soot after playing it. If you like trains (and who doesn't?) buy it. (N.J.M.)

# TUDOR RADIO

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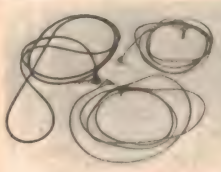

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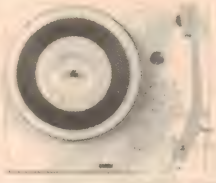

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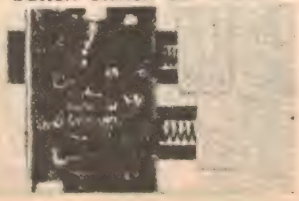

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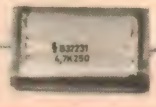

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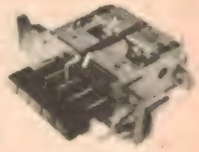

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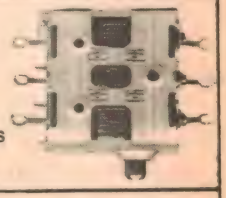

Tuning Condensors **50 cents**

## VARIETY FARE

**THE BEST OF BING. Bing Crosby MCA 2 Record set Stereo DXSB7184 Astor release.**

The years have dealt kindly with the recording masters used in this two record set of Bing Crosby hits over two or more decades of popularity, including his best ever success, White Christmas. Other old favourites include: Where the blue of the night meets the gold of the day — Swinging on a Star — You are my Sunshine — Sweet Leilani — I'm an old cowhand — Pennies from Heaven — Don't fece me in — Mexicali Rose — Play a simple melody — Galway Bay — In the cool cool of the evening — Now is the hour; there are twenty four hits in all.

The sound quality is fair. The stereo enhancement does not do very much for the music, but if you like Bing you'll like this two disc set anyway. (N.J.M.)

★ ★ ★

**THE WORLD OF DUDLEY MOORE Vol 2. Decca stereo SPA 286.**

Besides being a very funny man, Dudley Moore also heads a fine jazz trio called, appropriately enough, "Dudley Moore Trio". On this album, which has been electronically re-processed for stereo, they belt out nine tunes in fine old style. A most listenable disc at the reasonable price of $2.99. Sound quality is good.

A list of the tracks reads: I Love You Samantha — Yesterdays — Field Day For Shirley — Straight Life — Exactly Like You — If You Were The Only Girl In The World — You'd Be So Nice To Come Home To — Blues For Boots — Fly Me To The Moon. (L.D.S.)

## *Jazz and Rock . . .*

**BREAKS, WORKS AND THOUGHTS. John J. Francis. Warner Brothers stereo WS 20009.**

Francis and his accompanist Alan Luchetti on flute and recorder take a band along with them for this entertaining LP of ballads.

Francis is an accomplished writer and performer of ballads who is well known on the folk circuit. His professionalism has resulted in a superb recording, his second.

The opening is the humorous "Liberated Roadside Lady" followed by a sentimetal rustic piece called "Simple Ben."

Other good songs are "What To Do" and "A Wind is Rising." The record was engineered by David Gibson and Francis at Copperfield Sound Studios. Francis and Luchetti double tracked a number of the instruments. The LP, in my opinion, needs more bass sound to round it out. (G.W.)

★ ★ ★

**TESTIMONIAL. Spectrum, Incredible Murtceps. EMI stereo EMC 2503.**

This was the final recording by the group which played as Spectrum to the thinkers and Murtceps to the rockers.

Mike Rudd's songs continue to dominate the group, with songs "Real Meanie," "Homesick Valium Blues" and "Singing the Blues."

The group rocks more than it has done on previous recordings, probably due to a personnel change.

Members are Mike Rudd on guitars, Ray Arnott drums, Bill Putt bass guitar, John Mills keyboards and synthesiser. Arnott is the group's second composer and he collaborated on the excellent "Essay in Paranoia."

The sound of the group is superb and was captured at Bill Armstrong's studio No. 2 Melbourne on Optronics' 16-track machine by engineer John Sayers. Later mixing was undertaken at EMI's Sydney studio.

Spectrum / Murtceps had a great sense of style and the recording does them justice. (G.W.)

★ ★ ★

**BETTER DAYS. Paul Butterfield Band. Bearsville stereo BR 2119.**

Butterfield's harmonica shares the lead on this disc with guitarists Geoff Muldaur and Amos Garrett.

The LP is a nicely spaced recital of blues and ballads with a blues intonation. "Baby Please Don't Go" a classic by Big Joe Williams is a typical country blues recreated with dedication by the band.

This feeling of reverence is summed up in the lyric of "Buried Alive in the Blues" by the group. (G.W.)

★ ★ ★

**THE WORLD OF CHRIS BARBER. Decca stereo SPA 254.**

We've heard it all before but there comes Britain's cleanest sounding jazz band with a dozen bright trad jazz performances.

Lonnie Donegan sings "Rock Island Line" and "John Henry" with the group. Ottilie Patterson sings "I Hate a Man Like You" and "Weeping Willow Blues." It's predictable and bright jazz. (G.W.)

★ ★ ★

**A WIZARD A TRUE STAR. Todd Rundgren. Bearsville stereo BR 2133.**

A musican who "plays" a whole recording studio should be of interest to the stereo buff. Rundgren makes extensive use of electronic gimmickery to build his material. Sound effects, synthetic rhythm, a synthesiser are only part of the Rundgren fantasy.

Originality gets top marks but the tunes on the fantasy side, number one, aren't good enough. The disc's second side has a better pace and shows Rundgren's sure touch with love songs. "I Don't Want to Tie You Down" is the best of them. (G.W.)

★ ★ ★

**FUNKY SERENITY. Ramsey Lewis. CBS SBP 234299.**

Keyboard man Lewis plays Wurlitzer electric piano for this album of delicate jazz. He also has a fly at a Fender Rhodes electric piano, electric harpsichord and Steinway concert grand. The switched on Mr Lewis is backed by bass and drums which give him an Afro beat.

A version of "Nights in White Satin," featuring Ed Green on electric violin is a bit of a bore and out of character with the rest of LP.

"Kufanya Mapenzi" (Making Love) is the interesting opener to the disc. (G.W.)

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DC Current: 50uA, 5mA, 50mA, 500mA.
Resistance: 5K, 50K, 500K, 5M.
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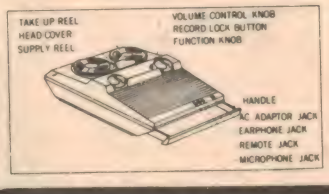


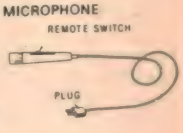


# RADIO HOUSE PTY. LTD.

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# PRODUCT REVIEWS AND RELEASES

## Sony videocassette records PAL

Back in April 1972, you may recall, we announced that the Sony Corporation of Japan had launched their "U-Matic" colour videocassette system based on ¾-inch magnetic tape. Now Sony have expanded the system with the VO-1601D recorder, which will record and play colour signals recorded to PAL-system standards. Jacoby Kempthorne Pty Ltd sent us a sample of the new machine to allow us to judge its performance, along with a type CVM-1320E Trinitron monitor.

Since the first launching of the U-Matic system, it has gone from strength to strength. Sony themselves have sold large numbers of U-Matic players and recorders, including some impressive orders from big US firms such as Ford Motor Company, IBM, Pepsi-Cola and Coca-Cola. Not only this, but other Japanese manufacturers have produced machines using the U-Matic format, and it has become one of the three EIAJ standard videocassette formats.

Sony's release of this new PAL-compatible U-Matic recorder should therefore be of particular interest, as it will allow Australian users to maintain compatibility between CCTV program material and broadcast material. At the same time the recorder is still capable of playing NTSC-standard cassettes, if required, making it very versatile.

The VO-1601D recorder is very similar in appearance to the original VO-1600 NTSC recorder. Its measurements are virtually identical at 616 x 205 x 465 mm, and the weight is still a hefty 27 kg. The only obvious difference externally is that the PAL machine lacks the receiver front-end fitted to the NTSC model, being designed to record only from video and audio line inputs. Presumably Sony opted for this approach to avoid the problems of trying to cope with the various CCIR/PAL broadcasting standards.

As with the NTSC machine, the VO-1601D has two audio channels. These may be used for stereo or for bi-lingual commentaries, etc. There is provision for track-to-track transfer dubbing, to allow substitution for faulty sound takes, and also provision for re-recording both sound tracks without disturbing the video. There is also provision for monitoring by means of 8-ohm stereo headphones, in addition to the audio line outputs.

The machine will record both monochrome and PAL colour video, providing it is to CCIR standards. Its 75-ohm video input will accept video of between 0.5V and 2V peak-to-peak, with inbuilt recording AGC to obviate the need for manual adjustment of video recording level. The same applies with audio recording — there are no recording level controls, meters or other indicators. This makes the unit very suitable for use by non-technical people.

Rated horizontal resolution for monochrome recording and playback is better than 300 lines, and for colour better than 240 lines, with a video signal-to-noise ratio of better than 40dB. The rated audio response is 90 — 10,000Hz, again with a signal-to-noise ratio of better than 40dB.

An ideal partner for the VO-1601D machine is the CVM-1320E Trinitron colour monitor receiver, which has been specifically designed for the purpose. Using the well-established 33-cm (13 inch) diagonal 90 degree Trinitron tube, it will automatically produce stable pictures from video input comforming to either EIA / NTSC or CCIR / PAL standards. It is also equipped with both VHF and UHF tuners, and a receiver front-end designed for CCIR / PAL signal reception.

The monitor is very compact, measuring only 520 x 360 x 400 mm and weighing only 19.5 kg. It comes in a very attractive teak veneered wooden cabinet, and is complete with a VHF telescopic dipole antenna. Features include automatic fine tuning on receive, and automatic colour correction (ACC) on NTSC playback.

Manual controls include a combined brightness / contrast control, colour saturation and hue controls, and a TV / line / VTR switch. The "VTR" here refers to an 8-pin combination socket which mates with Sony reel-type VTRs, by the way; the U-Matic connects via the line inputs and outputs.

We were able to try the recorder and the monitor out, using both a Sony NTSC colour demonstration cassette and a cassette with a variety of locally-produced commercials and similar items recorded to PAL standards. Both cassettes had been played numerous times, and were perhaps not ideal for demonstrating the full capabilities of the U-Matic system. Still, the performance was very impressive.

As one might expect from a closed-circuit situation, the fifferences between NTSC and PAL were virtually undetectable. Both gave a very stable picture, with no obvious differences in either hue or saturation stability. As with virtually all VTRs using tape smaller than 1-inch, there is a noticeable noise level present on the replay signal as a background "snow", but apart from this and the slight resolution drop, the pictures produced on replay are very acceptable.

Of course, the monitor with its Trinitron tube shows the pictures off to good ad-

*(Continued on page 113)*


*The Sony U-Matic VO-1601D colour videocassette recorder, with the CVM-1320E Trinitron monitor in the background. Both are PAL compatible.*

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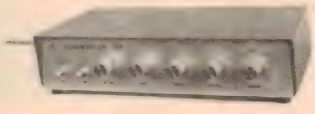
## PLAYMASTER 136



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|---|---|---|---|
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| BC109 | 10 for $3.20 | | |

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CAPACITOR PACKS: Pack 93 contains 3 top grade "Greencaps" of the 45 values between 2 pf and 0.47 uf, a total of 135. Terrific value at $8.30.

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The G11 –205 provides for a very modest outlay, most record playing facilities required by the user including 4 speeds and your choice of either automatic or manual play. This unit will enhance the performance and appearance of any audio system. Price **$27.70** Pack / Post: **$3.00.**

**G11-202**
This unit has all of the above features with the exception of the platter which is of pressed steel to combine high quality with economy for the budget conscious. Price: **$43.00** Pack / Reg. Post **$3.00**

**G11-301**
This top line automatic turntable features: A 4 pole synchronous motor driving a fully precision machined cast platter. The tubular tone arm has full balance and weight adjustments including cue pause control. Anti skate correction in also provided, These facilities combine to give superb performance with attractive styling to make this the best value for its price today. Price: **$56.00** Pack / Reg Post **$3.00.**

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# Two new multimeters from University Graham: good performers

University Graham Instruments Pty Ltd have now introduced two new attractive multimeters to their range. Both meters have clean styling, diode protection of the meter movement, excellent frequency response on the AC voltage ranges and an OFF position on the range switch which applies damping to the meter movement.

Designated MVA-50 and CTN-500MP, the new meters are attractively styled in light, impact-resistant black plastic cases. The range switch is easy to manipulate and the range markings are screen-printed in an easily readable type size. An important feature of the range switch of both models is that it can be switched to "OFF". This has two advantages: first, it connects a shorting ling across the meter movement to electrically damp the movement and protect it against vibration; second, if the user develops the habit of switching to OFF each time he finishes using the unit, he is less likely to overload the unit on the next occasion of measurement.

Both meters have diode protection designed to prevent damage to the meter movement in the case of overload. However, if the overload is maintained for any longer than a few seconds the internal multipliers or shunts are likely to be "cooked". Both meters have a mirror backed scale to eliminate parallax error when taking measurements.

Ranges on the CTN-500MP are as follows: DC voltage (FSD), 2.5, 10, 50, 250, 500 and 5000; DC current, 50uA, 5mA, 50mA and 500mA; AC voltage, 10, 50, 250, 500 and 1000; Ohms, x1, x10, x100 and x1000. The top calibration on the Ohms scale is 10k, so that resistors from 0.5 ohm to 10 megohms can be conveniently measured. DC sensitivity is 20,000 ohms / volt and AC sensitivity is 10,000 ohms / volt.

DC and AC voltage ranges were checked for accuracy and found to be well within the usual tolerance limits of 3pc of FSD. Frequency response of the 10 VAC range was surprisingly good, at 30Hz to 300kHz within 1dB. On the higher AC voltage ranges, the response began to rise above 100kHz.

*These two multimeters from University Graham have excellent frequency response.*

Ranges on the more elaborate model MVA-50 are as follows: DC voltage, 0.5, 2.5, 10, 50, 250 and 1000; DC current, 50uA, 5mA, 50mA, 500mA and 10A; AC voltage, 3, 10, 50, 250 and 1000; Ohms, x1, x10, x100, and x1000. The top calibration on the Ohms scale is 16k and mid-scale reading is 100.

In addition, the voltage and current scales can be doubled in FSD sensitivity, for example, the 0.5 VDC range becomes 0.25V, by pushing a slide switch to the appropriate position. This effectively doubles the available voltage and current scales. DC sensitivity is 50,000 or 25,000 ohms / volt, depending on the slide switch setting; AC sensitivity is 10,000 ohms / volt.

Accuracy of the MVA-50 was found to be also within 3pc of FSD and the larger scale (compared with the CTN-500MP) makes readings easier. Frequency response on the 3 and 10VAC ranges was the same as for the CTN-500MP and the higher ranges exhibited the same rising response at above 100kHz.

Both multimeters have decibel scales and a table of dB additions on the meter face for switching from range to range.

In summary, both meters are well made and easy to use and should serve the technician or hobbyist very well. They are supplied complete with batteries, test leads and instruction book and are available from wholesale electrical outlets throughout Australia. Price of the MVA-50 is $25.00 plus tax while the CTN-500MP is $14.00 plus tax.

Further information can be obtained from University Graham Instruments Pty Ltd, 106 Belmore Road, Riverwood, NSW, 2210.

## Sony videocassette, contd.

vantage. Quite apart from the excellent colour brightness, resolution, colour purity and accurate convergence of the Trinitron, there is the added factor of optimum screen size. It is now quite widely accepted that to display signals from a 1-inch or narrower tape VTR to best advantage, considering their resolution, stability and signal-to-noise ratio, a tube with a 33 cm diagnoal screen is just about perfect. Research sure does make the difference!

Summarising, the VO-1601D U-Matic recorder and the CVM-1320E monitor are very well engineered units, and go together to produce a low cost PAL-compatible colour videocassette system capable of very impressive performance. For education, training and similar applications requiring colour, they should prove just as popular as the original NTSC designs.

For further information, contact Jacoby Kempthorne Pty Ltd at 469 Kent St, Sydney, or its offices in each state. (J.R.)

# Soldermaster desoldering tool

Technical & Scientific Equipment Co Pty Ltd have available the new models of Soldermaster desoldering tools which have temperature control.

Both Soldermaster models may be described as a temperature-controlled iron fitted with a solder catchpot and an interchangeable hollow bit through which the solder is drawn by a vacuum applied by the operator. The vacuum source is an Austen Capex MkII diaphragm pump driven by a shaded pole motor. The pump is protected from resin fumes by a micro filter in the vacuum line.

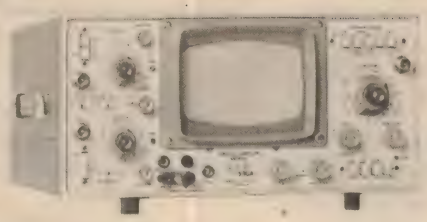
A Weller 100W temperature-controlled iron is used to obtain a fast recovery rate after each desoldering operation and to prolong bit life by limiting the maximum temperature. A range of bits is provided to suit different components.

Further information on the Soldermaster range may be obtained from Technical and Scientific Equipment Co pty Ltd, GPO Box 241E, Melbourne, 3000.

NEW PRODUCTS

## Low cost dual-trace CRO from BWD

BWD Electronics has released a new locally-designed and manufactured portable dual trace oscilloscope which they claim sets a new level for high performance and functional flexibility at a low price.



The new instrument is known as the model 530A. It offers twin vertical amplifiers with identical bandwidth of DC — 20MHz and sensitivity of 1mV/cm maximum. The signals from the amplifier channels may be applied to the single gun tube plates either alternately, in chopped mode, or in additive combination. One channel may be inverted in polarity if desired, while X-Y display of the channels is also provided for, at the touch of a button.

Timebase sweep range is from 40ns to 10s/cm, including the effects of a x5 magnifier switch and a vernier control. The timebase may be disabled for X-Y operation, and also switched for single-shot operation, in each case by means of a front-panel pushbutton.

A wide variety of triggering modes are provided, including fast and slow TV, AC line, either vertical channel, external, etc. Triggering performance extends to 40MHz.

The CRT used boasts a large 6 x 10cm screen, with internal graticule to permit parallax-free measurements. Internal calibration facilitities are provided.

The 530A measures a compact 16 x 31 x 42cm, and weighs only 8.5kg with the mains power option. A battery power option is also available if required.

Cost is $575 FIS capital cities. Further information is available from BWD Electronics Pty Ltd, 331-333 Burke Rd, Gardiner, Vic 3146.

## New semiconductors from Elcoma

A number of new devices of interest to equipment manufacturers and experimenters alike have been announced by the Elcoma Division of Philips Industries Ltd. Falling mainly into the opto-electronic category, they include a seven segment display, a 100mW LED, two photo-transistors, a light activated SCS and an IC designed for crystal controlled clocks and watches.

The seven segment display, listed as the CQY 25, is packaged in a ten lead red epoxy case with characters approximately 2.5mm high. It can show numerals from 0 to 9 with a decimal point and letters A,C,E,F,H,-J,L,P and U. With a total power limit of 160mW, each segment can be run at 10mA continuously or 30mA pulse.

Designers with a use for LED's will find interest in the CQY 24, a 100mW device in a standard 5.08mm dia red plastic encapsulation. It has an emission peak at 680mm, as does the CQY25.

On the receiving end there are two phototransistors and a light activated SCS, the BPX66P. The BPX70 and 72 differ only in their sensitivity, with the BPX72 being approximately 4 times as sensitive. They share a similar construction, being mounted on a TO18 header with a plastic lens cover.

The BPX66P, in a modified T072 can with a flat glass window, is designed to switch currents up to a peak of 10 A. Two of the recommended applications are in light operated relays and for the slave flashing of electronic flash and quench tubes.

Those with a need for accurate timekeeping will find interest in the SAJ 250A7⅛B crystal clock IC, which is available in either a T099 or 8 pin DIL package. Together with a crystal cut for 32.768 kHz, a trimmer capacitor, 1Hz stepping motor and a single cell mercury battery, it forms the heart of a precision time piece. The IC includes the crystal oscillator, divider chain and output stages, together with output voltage stabilization.

Information on these devices may be obtained from Elcoma offices in all states.

## A&R catalogs

The A&R-Soanar Group announce the availability of their stock products catalog for 1974, a 52-page publication giving comprehensive data on their range of transformers, electronic equipment and components. The catalog is profusely illustrated, and gives all essential specifications and design parameters on the products concerned.

Also available is a four-page short form catalog, giving basic information on the same product range, in convenient form.

Both catalogs are available free in response to requests on company letterhead, which should be directed to the company at 30-32 Lexton Rd, Box Hill, Vic 3128.

## Industry News

GENERAL ELECTRONIC SERVICES have moved into new larger premises at 99 Alexander St, Crows Nest 2065. The phone numbers remain 439 2488, 439 2399, 43 5165; telex has also been installed, the number being AA 25486. Mr Blake Roberts has joined the company as Sales Engineer, Components. Mr Geoff Harrison has also joined GES as Office Manager.

ALLIED CAPACITORS PTY LTD has been purchased from Hawker Siddeley Electronics by Mr Alleyne Bowler and Mr Karl Trankle, and will expand its activities in the local manufacture of a broad range of electronic components. Mr Gordon Smith continues as Marketing Manager and Mr Bernard Heybroek as Technical Engineer.

### DVOM OFFER CLOSED

Readers are advised that the special offer kit of semiconductor components for the DVOM of January-February is no longer available. However the components are available individually at normal prices, via Fairchild Distributors in all states.

# AMATEUR BAND NEWS & NOTES

by Pierce Healy, VK2APQ

## 16th Jamboree-on-the-air

Not a contest, but a joint effort by Scout associations and amateur radio operators throughout the world to bring young people together by means of the most facinating modern mode of communication.

The 16th Jamboree-on-the-Air will be held over the weekend 20th — 21st October, 1973. J-O-T-A is not a contest, but a means of providing, through amateur radio, links for Boy Scout and Girl Guide groups throughout the world to exchange greetings. Also to learn first hand of cultural and other activities in which they may share a common interest.

Acquaintances made by both individuals and groups during past events have resulted in friendships of a very rewarding nature.

It is also an opportunity for amateurs to provide a service to the community. It will enable young people, whether in the densely populated cities, coun ry towns, or sparsely populated areas, to exchange messages of goodwill with those of their own or an overseas country.

There is no doubt that in some areas communication through the amateur satellite OSCAR 6 will provide a new and exciting experience.

However SSB transceivers on the HF bands will no doubt provide most contacts with overseas stations. VHF bands are recommended for contacts betweer. local groups.

A bulletin issued by Noel Lynch, VK4ZNI, National Organiser for the Jamboree-on-the-Air gives the following information from the Boy Scouts World Bureau, Geneva. "The starting time will be 00.01 hours local time on Saturday, 20th October, 1973 and will terminate 48 hours later at 23.59 hours Sunday, 21st October, 1973.

"The basic rules remain unchanged, as follows:—

1. Advise the Branch organiser of your intention to participate.
2. Observe national licence regulations — branch organisers or amateur radio friends can advise on these.
3. Use any authorised frequency or mode of transmission.
4. Send in a report to branch organisers afterwards.

"This year's participation certificate had been designed by a Brazilian Scout and is a most attractive one. Bulk supplies have been sent to national organisers and made available to participating groups.

"Thanks to a grant from the Japanese Expo '70 foundation we have been able to produce a 16th J-O-T-A poster. Supplies will be forwarded direct to national organisers for distribution."

Amateurs wishing to participate by inviting local groups to their station or willing to operate portable from a scout hall or camp site should contact their local group. If no local contact is known then contact a branch organiser.

The following are branch organisers for the 1973 J-O-T-A;8

Papua / New Guinea:
Geoff Perkins
PO Box 5395, Boroko. Papua New Guinea.

Queensland:
Branch H.Q. Commissioner Ian Clarke.
C / o Queensland Branch Headquarters,
Box 50, Broadway, Brisbane, Qld 4000.

New South Wales:
Mr Ray Lawrence,
Branch Commissioner for Leader Training,
New South Wales Branch Headquarters
203 Clarence Street, Sydney, NSW 2000.

Victoria:
Mr Leslie D. Marmo
50 Howitt Street
South Yarra, Melbourne, Vic 3141.

Tasmania:
Mr Ray Jeffrey
8 MacRobie Road, South Hobart, Tas 7000.

South Australia:
Mr Steven Johnston, VK5ZNJ
7 Hayles Road,
Elizabeth Park, Adelaide, S. Aust. 5113.

Western Australia:
Branch Headquarters Commissioner Peter Hughes, VK6HU
58 Preston Street,
Como, Perth, W. Aust. 6152.

The popularity of the event is indicated by the particpation figures for Australia in the 1972 J-O-T-A.

| | |
|---|---|
| Amateur stations | 430 |
| Scouts and Scouters | 10564 |
| Gudes and Guiders | 3186 |
| Scout Groups and Districts | 959 |
| Guides and Guiders | 360 |
| Contacts between Australian Stations | 5049 |
| Contacts with overseas stations | 1457 |

### REMEMBRANCE DAY CONTEST

From the activity on the bands, the 1973 Remembrance Day contest appeared to be very successful. The opening address was given by Mr Myles Wright, chairman of the Australian Broadcasting Control Board.

The address contained references to current thoughts among those associated with radio engineering and broadcasting. These are matters which, as amateurs, we should give some deep thought.

In his address Mr Wright said:—

"I am very pleased to have been invited to open the 26th Remembrance Day Contest of the Wireless Institute of Australia. Not least, because I notice it involves amateur operators in New Zealand. As a New Zealander by birth, I am pleased to make special reference to the operators from Maori land, and in particular to any listening in my own home town of Wellington.

"Having been involved for about half my working life in the professional side of radio, in front of the microphone, as well as behind a desk, I can understand the attraction which radio holds for amateur operators. I have heard it said, that radio amateurs could more conveniently, and frequently I suspect much less expensively, conduct their natter sessions using the modern telephone system.

"I can fully understand their retort — that is not the same thing — talking over the telephone to just one single captive listener.

"The thrill of broadcasting a message to an unseen and unknown audience far transends a mere telephone call, and in addition, with the true radio amateur there is the technical challenge.

"I trust that this challenge to investigate and invent new techniques is not completely lost now that such an elaborate professional amateur radio station, if you will excuse the paradox, can be purchased off the shelf as it were.

"I sincerely hope that there are still amateurs who are not only building their own equipment but building in new ways to operate on the newer wave bands.

"It was this technical inventiveness and thorough technical knowledge which it developed, that fitted amateurs so well for the duties so many undertook during the war years. Too many of these, now names on the Remembrance Day Trophy.

"In my present position as chairman of the Australian Broadcasting Control Broad, it would be remiss of me if I failed to use this opportunity to say a few words on the inter-action between amateur radio operations and the broadcasting services of Australia and New Zealand.

"You are all aware of the dreaded initials 'TVI'. With colour television beginning in New Zealand in a few weeks, and in Australia in about eighteen months, interference from amateur transmissions to television programs is under careful scrutiny. The board's engineers tell me that there is very ready co-operation from amteurs in minimising interference to television.

"However, viewers will be investing large sums in their new colour television set, so we can expect an increase in their reaction to any marring of quality in reception.

"My board is anxious to ensure that viewers derive the greatest benefits possible from the purchase of their expensive colour television sets. And the technical staffs of both the board and of the post office will be ready to help both the public and the amateur radio operators, either individually or collectively through the Wireless Institute in solving the TVI problems which will arise when colour services begin.

"While on the subject of interference let me also refer to the problems and indeed the responsibilities we all have, professional and amateur alike in using the precious radio frequency spectrum. The one important advantage which this natural resource possesses, compared with many of the other natural resources, is that the radio spectrum is not irrecoverably consumed. It may be misused but, with wise management and co-operation between users, the position can be recovered.

"Now in the case of the spectrum, I believe that the broadcasting users and the amateur radio users, have a common complaint that they do not have sufficient channels. At the same time we must both keep our own house in order to ensure that we use the channels which

*A typical J-O-T-A group. The operator, front row, is Jack Morris, VK4JQ. On the right, back row, wearing glasses, is Noel Lynch, VK4ZNI, National Organiser J-O-T-A for the Australian Boy Scouts Association.*

Radio clubs and other organisations, as well as individual amateur operators, are cordially invited to submit news and notes of their activities for inclusion in these columns. Photographs will be published when of sufficient general interest, and where space permits. All materia' should be sent direct to Pierce Healy at 69 Taylor Street, Bankstown, 2200.

we do have to the very greatest advantage and that we do not cause trouble to our neighbours.

"We must develop good house-keeping methods, reduce the amount of pollution and rubbish which we produce and above all we must attempt to keep our polution within our own back yards.

"As so many of you will know, this simple house-keeping in the radio spectrum is now being promoted as a specialised topic within the field of radio engineering, with the elaborate name 'electromagnetic compatability'. No doubt we shall all be learning a great deal more about it in the near future.

"Now, in conclusion, let me on behalf of the broadcasting fraternity, in this our golden jubilee year, acknowledge the role which the radio amateurs individually and as a group have played in the development of radio services generally in Australia and New Zealand. In particular let us recall the important roles your members played and the sacrifices they made during the war years.

"And now I have great pleasure in declaring open the Remembrance Day Contest.

"I hope it is a very great success".

## WIRELESS INSTITUTE ACTIVITIES

### VHF Repeaters

On the WIA Victorian division station VK3WI the following item was broadcast on Sunday 12th August, 1973.

"An extraordinary convention of the WIA will be held in Melbourne on 15th September, 1973. The expressed purpose of this convention is to decide the question whether the VHF FM repeaters are to be changed in accordance with the Albury plan or remain unchanged.

"This convention has been called by the South Australian division federal councillor, Mr Geoff Taylor, VK5TY, in accordance with the companies act. The venue of the convention is the WIA Victorian division headquarters, 478 Victoria Parade, East Melbourne."

This notification was confirmed at the NSW division general meeting held at Wireless Institute Centre, 14 Atcheson Street, Crows Nest, on Friday 24th August, 1973.

By the time these notes are read the convention will be over and the decision known. However, at the time of writing it is difficult to understand why an expense of several hundred dollars of Institute funds should be incurred by delegates travelling to Melbourne. After all it is only little more than six months before the annual meeting is scheduled to be held in Sydney in 1974.

Furthermore, the problem, while important to those concerned, does involve only one small facet of the amateur scene. There would be no great tragedy if a decision was delayed for a few months.

### Radio Control of Models

The Controller, Regulatory and Licensing, PMG's Department, Mr H. Young is reported to have put forward the suggestion that the WIA confer with modellers' clubs and possibly work out a gentleman's agreement on sharing the 11 metre band when novice licensing becomes a reality.

Apparently, radio controlled aircraft hobbyists are concerned that interference will become much greater with the increase in band usage by novice licensees.

They believe their aricraft could suffer loss of control with consequent dangers.

Two bands are available for radio control: 26.557MHz to 27.282MHz and 40.60MHz to 40.70MHz. The latter is seldom used because equipment that comes from overseas uses the 11 metre international band.

Model enthusiasts operate under a PMG's Department permit, with no licence. This restricts them to two watts transmitter input and their aircraft must not fly above 92 metres or out of sight.

It appears that the Department would prefer an amicable sharing arrangement between licensed amateurs and aircraft modellers. To this end, suggestions are being sought from WIA members.

### NSW Division

The inaugural meeting of the WIA NSW Division Ladies Auxiliary was held on June 20th, 1973. Concepts and the role of the auxiliary evolved from that meeting were:

1. To create, plan, and implement social programs into the NSW Division, WIA, for the involvement of all members of the WIA and activities for the involvement of the whole family unit.
2. To assist planning of major programs and functions as to venue, accommodation and catering.

Social programs: Because of catering commitments it will be necessary to purchase tickets prior to the function. Tickets will not be available after the published closing date. Details of events will be given over Divisional broadcasts, the Division's mini bulletin, and Tuned Lines.

For additional information telephone Mrs Judy Deans at Wireless Institute Centre on 43 5795 or Mrs Ann Griffith on 428 3947.

The first function will be a "Progressive Dinner" to be held on Saturday evening 27th October, 1973, commencing 6.30 pm at the home of VK2ZTD, Berowra, then moving to VK2AD's home at Hornsby and finally to the home of VK2ACV at Carlingford.

Tickets are $5.50 per person and cover all food and drinks. Closing date for tickets is 12th October, 1973.

Children's Christmas Party: So that arrangements can be made for entertainment, gift purchasing etc, and to ensure an enjoyable Saturday afternoon for Mum, Dad, grand-parents and children, an early indication of the numbers is required.

Please send the following details, with remittance, to WIA Ladies Auxiliary, 14 Atcheson Street, Crows Nest, 2065, before Wednesday 31st October, 1973.

Surname ..... Call sign .....

Child / Grandchild ..... First name .....

Sex .....

Fees: Members; $1.00 for first child, $1.50 for two children, $2.00 for three or more children.

Non-members: $1.00 for each child.

Remittance to be made payable to "WIA Ladies Auxiliary".

The venue is the Division's transmitting station, Quarry Road, Dural.

Date; Saturday, 1st December, 1973.

### Hunter Branch Field Day

The 1973 Hunter Branch Field Day will be conducted from the Teralba Community Hall, Anzac Parade, Teralba on Sunday 21st October, 1973, commencing 9.00 am.

Entry will be free to WIA NSW Division members. However, there will be an entry fee of 50 cents for the field events.

For non-WIA members the registration fee will be $1.00 per person. Children under 12, if accompanied by an adult, will be admitted free. Children over 12 and under 18, 50 cents. The fee of 50 cents for field events will not apply to non-WIA members.

Program:—

9.00 am Registrations

9.30-10.00 am 144MHz talk-in contest

10.15-10.30 am 144MHz pedestrian transmitter hunt

10.30-11.30 am 144MHz two transmitters mobile hunt.

11.45-12 noon 7MHz pedestrian transmitter hunt

1.00-1.15 pm 160 metre pedestrians transmitter hunt

1.15-1.45 pm 7MHz transmitter hunt for mobiles.

2.00-2.30 pm All band scramble. HF and VHF sections.

2.30-3.00 pm 144MHz talk-in transmitter hunt.

3.15-4.15 pm 144MHz two transmitters mobile hunt.

1.15-4.15 pm Entertainment and competitions for the ladies.

4.30 pm Presentation of prizes.

The Hunter Branch WIA committee cordially invites amateurs and their families to this annual event to meet old friends and make new acquaintences. You can be assured of an enjoyable outing for the whole family.

An invitation is also extended to visitors to attend the Hunter Branch monthly meetings held in the Technical College, Tighes Hill, Newcastle, commencing at 8.00 pm, on the first Friday of each month. Full details from the secretary, Ray Leben, 49 Valaud Crescent, Highfields, 2289.

### Blue Mountains Branch

The Blue Mountains Branch of the NSW Division, WIA, extends an invitation to their annual field day on Sunday 25th November, 1973.

Venue: Lawson swimming pool grounds, Lawson. Good facilities are available, including barbeques.

Program:

10.00 am Registrations. Fee $1.50

9.30 am-10.30 am Enroute all band scramble. One log HF and VHF. Any mode including net channels.

11.00 am-11.45 am Pedestrian sniffer hunt. 144MHz

12.00 noon Lunch

0.1.00 pm — 02.00 pm Mobile fox hunt, 144MHz, 146MHz and 52.525MHz.

2.30 pm-3.30 pm Mobile "Talk-in" fox hunt, 146MHz and 52.525MHz.

3.30 pm-4.00 pm 7MHz scramble.

For the ladies, blindfold sniffer hunt.

4.00 pm Presentation of prizes.

Rules for the "Talk-in" fox hunt:

— Normal road rules apply.

— No beams permitted

— Ask as many questions as you like. Answers will be yes or no.

— First in wins.

Drinks and ice-creams provided for everyone including 807's for the "OM's"

Bring the whole family.

An enjoyable day in the Blue Mountains is assured.

### Central Coast Amateur Radio Club

Work is progressing on the Central Coast Amateur Radio Club's clubrooms and station. President Dick Maitland, VK2BBK, expressed his appreciation to the volunteers among members. The club premises are in Dandaloo, Street, Kariong, just south of Gosford, off the Pacific Highway.

Three new members were welcomed at the August business meeting. These were George Clements of Woy Woy, a frequent visitor to the club in recent weeks, George Pile, VK2GP, of Toukley, and Don Dixon who holds a commercial operator's certificate.

Vaughan Wilson, VK2VW, an old identity in NSW amateur circles gave an interesting talk on the Civil Defence State Emergency Organisation in the central coast area. Members are giving some thought to amateurs in the area assisting the organisation. Further information is being sought on the subject.

It has been suggested that another series of AOCP classes be conducted on Saturday afternoons. Experience has shown that night classes are difficult to run, due to the limited nights on which both students and lecturers are available. Five instructors are needed. Ross Mudie, VK2ZRQ, Dick Maitland, VK2BBK and Vaughan Wilson, VK2VW have volunteered. The program will be drawn up by Ross, allocating sections of the course to each instructor. Each will be rostered for one Saturday afternoon in five to instruct the class. The classes will last four hours, commencing at 1.30 or 2.00 pm.

Ed Dyring has volunteered for the Morse code instruction.

Meetings are held on the first and third Fridays of each month at the club rooms. Visitors are welcome, particularly amateurs holidaying in the area.

Further details from the secretary, Barry Gibbons, VK2ZUX, PO Box 238, Gosford, 2250, or through the club's channel 1 repeater, VK2RAG. A call through the repeater will certainly put a traveller in the area in touch with a club member.

The Central Coast annual field day has been set down for 24th February, 1974.

### Illawarra Branch

The general meeting of the Illawarra Branch, NSW division WIA was held at the Wollongong Town Hall committee room on 13th August, 1973. Among the items discussed was the work necessary to turn the club room at North Wollongong into both an operational centre and a place where members can meet to read or research in the library, carry out construction projects, or meet socially.

The committee would welcome assistance from members who could devote a little of their spare time to this project.

Technical problems have made it necessary for the repeater installation to be transferred from Robertson to Figtree, where it will be made to work effectively for a month before returning it to the Robertson location.

The repeater committee set themselves the task of retuning it in the shortest possible time using new filters. Four copper tubes, 102 millimetres in diameter, 610 millimetres long have been made available by Metal Manufacturers, Port Kembla, at a moderate cost, for which the committee have expressed their sincere thanks.

It is also planned to replace the existing valve type unit with a completely solid state installation. A battery and trickle charger will be installed to run the unit off 12 volts DC thus immunising the system against mains voltage fluctuations.

Work is also being carried out on the UHF Moon-bounce project at Dapto. This included painting the antenna dish and structure.

Correspondence to the Illawarra branch should be addressed to PO Box 110, Dapto, NSW 2530.

### University of NSW Radio Club

The inaugural meeting of the University of NSW Amateur Radio Society (UNSWARS) was held on 1st August, 1973. Officers elected were:—

| | | |
|---|---|---|
| President | Sam Voron | VK2BVS |
| Vice-president | Philip Jones | VK2ZEH |
| Secretary | John Grote | —— |
| Treasurer | Bill Mather | VK4ZJW / 2 |
| Society organiser | Maurice Alafaci | VK2YBF |

Objects of the society are:—

(a) To provide a meeting place within the University of NSW for persons interested in amateur radio.

(b) To establish and maintain an amateur station at the University.

(c) To promote amateur radio inside and outside the University.

(d) Each year to establish a study group, commencing at the conclusion of the final yearly examinations at the University, to assist students or non-students to obtain an amateur licence.

The society hopes to co-ordinate its activities with other kindred societies by establishing a club net on

## AMATEUR NOTES

52.525MHz. For this purpose licensed members of the society will obtain suitable equipment. The society is interested in obtaining equipment for its proposed amateur station.

The officers extend an invitation to persons of any age, whether members of the university or not, to join the study group commencing late December, 1973. At this study group emphasis will be placed on assistance to candidates at the February, 1974, AOCP examination.

Study group applicants will receive details early in December. Applications should be directed to Sam Voron, VK2BVS, 2 Griffith Avenue, East Roseville, 2069, telephone 407 1066.

The society's postal address is — University of NSW Amateur Radio Society, The Union, PO Box 57, Kensington 2033, NSW.

### QUEENSLAND

#### Sunshine State Convention

The Sunshine State convention will be held on the weekend 6th and 7th October, 1973.

The venue will be the Amateur Wrestling Club Hall, 54 Phillip Street, Leichhardt, Ipswich. To help to locate the venue, red arrows with yellow letters will be affixed to telephone poles to point the way. Visitors should proceed through the main centre of Ipswich and along the old Brisbane-Toowoomba Road for 2 kilometres. Turn left into Chubb Street, 366 metres past the start of the Ipswich Golf Links, proceed to Phillip Street, third street on the right. The hall is the last building in that street.

This will be a fun convention, with lots to interest everyone. Wives and children welcome.

The hall will open at 8.30 am on Saturday, registration tags will be issued from that time. Morning tea and lunch will be available at the convention site.

Official opening ceremony: 2.00 pm, by Dr Edwards, the local member for Ipswich.

A bus tour for the ladies at 3.00 pm on Saturday.

A program of technical demonstrations and lectures as well as VHF hidden transmitter hunts and HF scrambles will fill the afternoon to 6.00 pm.

A Barbecue Dinner, commencing at 6.00 pm, will be available to red ticket holders. The bar will be open.

A film show and social get-together will complete the program for Saturday.

Sunday: Commence at 9.00 am with the WIA news broadcast over VK4WI.

Contests: Hidden transmitter hunts, scrambles etc will be featured during the morning.

An auction of disposal gear will be conducted between 11.30 am and 12.30 pm.

A smorgasbord lunch has been arranged at the North Star Hotel.

Awards and Prizes will be presented during the luncheon period.

Convention closes at 2.00 pm Sunday.

Registration should be sent to the Hon Secretary, WIA, GPO, Box 638, Brisbane, Queensland 4001.

### VICTORIA

#### Geelong Amateur Radio TV Club

On Friday evening, 20th July, 1973, a large group from the Club visited Channel 0 TV studios. The party saw "many weird and wonderful techniques" which are employed in the production of TV programs. Demonstrations of how the equipment worked and a sneak preview of colour TV were given. Appreciation was conveyed by the party to John Watkins, VK3EW and Jack Vertigan, VK3WR, who organised the evening.

A combined meeting of the Geelong Amateur Radio and TV Club and the Geelong Radio and Electronics Society, was scheduled to take place at the GARC clubrooms in August. Points for discussion were:—

(a) Proposed amalgamation of the South Western Zone and the Western Zone of the WIA, Victorian Division.

(b) Wireless Institute Civil Emergency Network — Geelong area. Appoint a Co-ordinator.

For details on the GARC write to the secretary, PO Box 520, Geelong, Vic 3220. Meetings are held every Friday night in the club rooms, Storrer Street, East Geelong.

### RADIO CLUB DIRECTORY

A final reminder to club secretarys and publicity officers. To be included in the "Club Directory" for December 1973, details must be received before 20th this month, October.

The idea is to publicise your club so that fellow amateurs, visiting or travelling through your area, can attend meetings and meet local operators.

Several letters were received too late for inclusion in the last list. Don't let yours be late this time.

## WIA YOUTH RADIO SCHEME

The NSW, YRCS supervisor, Kev Watson, VK2BLW, advises that Rex Black, VK2YA, founder of the WIA Youth Radio Club Scheme, will donate a copy of the book "The Heroes" to the first successful candidate to gain a novice licence. The book records the exploits during World War II of a small ship the "Krait." This ship sailed from Australia carrying a crew who blew up many Japanese ships in Singapore harbour. The radio operator on the first trip was Mr H. Young, now Controller, Regulatory and Licensing, Radio Branch, PMG Department.

The "Krait" is now used by the volunteer coastal patrol in Sydney.

Clubs registered with the NSW division YRCS in 1973 are:—

Swansea High School; Westlakes Radio Club; Denistone East Scouts; Maclean High School; St. George YRCS Radio Club; Homebush Boys' High School; St Michael's High School; Sydney Technical High School; Marist Bros High School Parramatta; North Sydney Boys' High School; Lower Mountains Radio Club; Maitland Radio Club.

### Novice Licence

The WIA has been advised by the PMG's Department, that ministerial approval has been received for the novice licence. Regulations are being drafted and will be passed by the end of 1973.

The novice grade licence examination will include:

Regulations at the normal standard;

Elementary theory paper;

Morse code telegraphy test at five words per minute.

No date has been announced for the first examination.

The format of the theory exam paper is under consideration.

### Westlakes Radio Club

The Westlakes Radio Club has received permission to transport a building, procured for a club house, from Dora Creek to a site made available by the council in York St, Teralba. To meet council standard much work will be required. The building will be renovated, painted and power connected. Toilet blocks erected and water service connected. It is also proposed to erect a lockup type garage to store equipment.

Two substantial donations have been received from persons outside the club but further support is necessary to enable the eight year dream of the club committee to have premises of its own.

Candidates who passed the recent junior certificate examination have received their certificates. The candidates, Graham Gallway, Henry Homer and Stephan Bates were also presented with a YRCS good work award; a bag of components. These incentive awards are given to all club students who are successful at YRCS certificate level exams. Similar awards are made to YRCS students who are successful at AOCP and AOLCP examinations.

Membership of the WRC is open to anyone interested in increasing their knowledge of radio and electronics. For details write to the secretary, Eric Brockbank, VK2ZOP, PO Box 1, Teralba, NSW 2284.

### Armidale Police Boy's Radio Club

The club is run as a section of the Armidale Police Citizens Boys' Club. Since its formation nearly three years ago nine members have gained YRCS certificates. Two have subsequently gained their AOLCP; Steven Boyd, VK2YAG and Michael Seery, VK2ZXE.

Club facilities include their own room for lectures and practical work, with separate rooms for YRCS classes. All other club facilities are available to members.

This is the only PCBC where radio courses are undertaken. Good financial support is being received, the less athletic pastimes having proved to be of value to members. It is believed that an SSB transceiver is to be presented to the club.

Several trips to places of scientific interest have been made by club members. These included the Satellite Communication Centre at Moree, the TV station at Mt Kaputar near Narrabri, the CSIRO Solar Research Station at Culgoora and the Cooney underground tidal observatory at Hillgrove, 26 kilometres from Armidale.

The club call sign is VK2BAA and the club leader, Bill Laird, VK2BLA.

### Maitland Radio Club

A complete 25 line automatic telephone exchange has been donated to the Maitland Radio Club. Known as a PAX45, it was built in London by the Siemens Company and stands in a rack 1.5 metres high. It has been superseded and is no longer required for commercial use. Ultimately, it will be used to provide communication throughout the club rooms and theatrette. The gesture on the part of Mr A. Nixon and the NSW general manager for GEC, Mr L. Lewis is appreciated by members.

More than 100 people attended the club picnic and mini field day held at the Lostock Dam on Sunday, 12th August, 1973. Organised by club member Phillip Lawrence, VK2ZYU, the event was a great success. Treasure hunts, transmitter hunts and contests requiring skill and effort were among the events held. Prizes for the successful contestants were to be presented at a social evening in the club theatrette on Saturday evening 22nd September, 1973.

On Saturday morning, 4th August, thirty club members were candidates at radio examinations held in the club rooms. The exams were for elementary, junior, intermediate and senior YRCS certificates. Mr C. G. Cooke, the club's examination officer, supervised the candidates.

Several of the club members who had been studying for their amateur licence were candidates at the PMG Department's AOCP examination held in August.

For information relating to the MRC write to the secretary, Box 54, PO, East Maitland, NSW 2323, or telephone Maitland 372282 or 337286.

### Successful Candidates

Results of the junior radio certificate exams held during the first half of 1973, received from Ken Hargreaves, VK2ZIL, were:—

Westlakes Radio Club: Credit grade — Peter Rutledge, Pass grade — Tim Baumfield, Peter Partridge, Ian Porteous, Bruce Steel, David Williams.

Maitland Radio Club: Honours grade — Malcolm Robertson. Credit Grade — Robert Ford, John Ambler. Pass grade — Geoffrey Buston, John Buxton, Robert Cummings, David Green, Ralf Jorg, Keith Leayr, C. Pillidge, Mark Piper, John Pitts, Davide Saville, Charles Spooner.

Newcastle Boys' High School: Honours grade — David Cottee. Pass grade — Richard Hallinan.

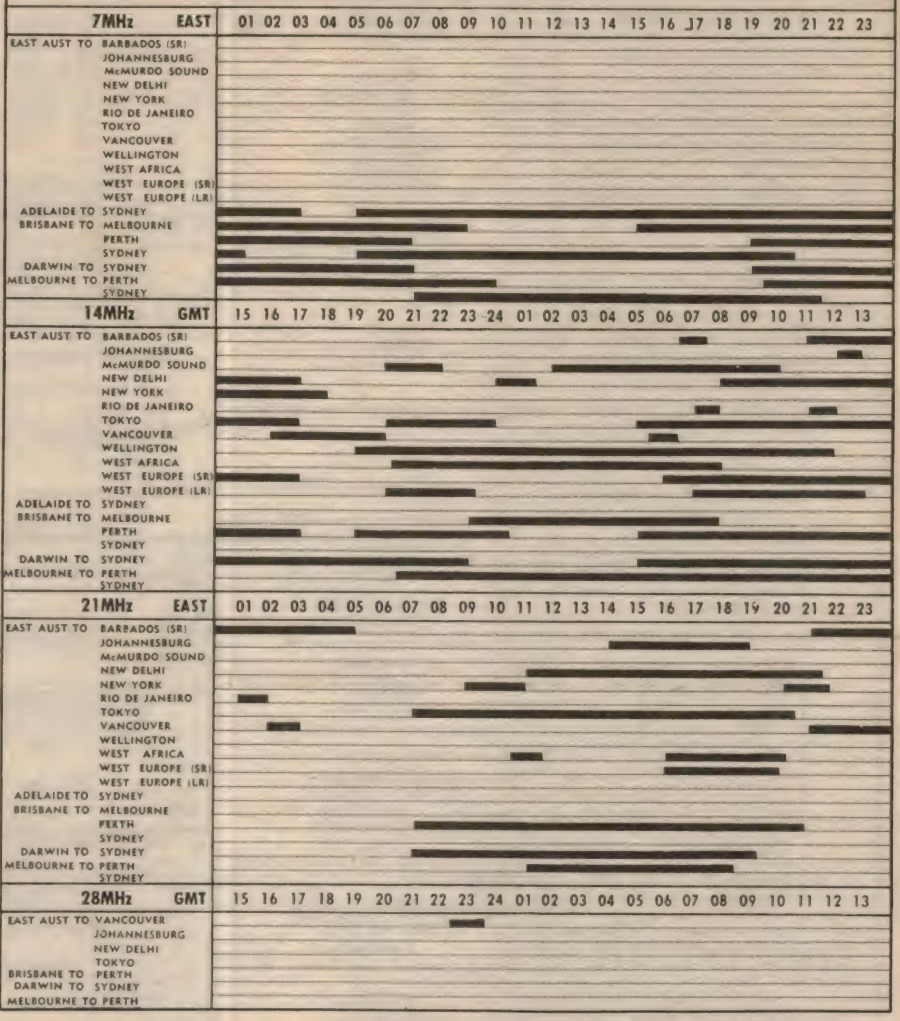
St George YRCS Training Centre: Pass grade — James Truant. Camp Technology: Credit grade — Adrian Parker. Pass grade — Gabrielle Fantin, David Hughes, Jill Rowling.

Yawarra: Credit grade — Stephen Frost.

Armidale Police Citizens Boys' Club: Credit grade — P. Chubb. Pass grade — Michael Halloway, Michael Orman.

## IONOSPHERIC PREDICTIONS FOR OCTOBER

Reproduced below are radio propagation graphs based on information supplied by the Ionospheric Prediction Service Division of the Commonwealth Bureau of Meteorology. The graphs are based on the limits set by the MUF (Maximum Usable Frequency) and the ALF (Absorption Limiting Frequency). They have been prepared for the four most popular amateur bands over a number of interstate and international circuits. Black bands indicate periods when circuit is open. **10.73**



### SOUND PROJECTORS

Cinevox Prefect and Harmour and Heath 16mm in good working order. 240v operated, complete with speaker and amplifier

**from $115.00**

### CIRCULAR SLIDE RULE

3¼in diameter. Will do the same work as the conventional slide rule. Instruction book included.

**from $1.60 each**

Post 12c.

### P.M.G. TYPE TELEPHONES

Standard desk type with magneto bell calling device. Range 30 miles. Uses standard batteries at each phone. Any number can be connected together on single line.

**$25.00**

(2 TELEPHONE SETS)

Including ¼ mile twin telephone cable $1 cartage to rail. Freight payable at nearest attended railway station.

### WHIP AERIALS

3 Piece. Tapers from 1" to ⅛". No Base $4.95. Shop Sales Only.

### 66VTVM

University Graham Tested $45 Post $1.00

### MINIATURE ELECTRIC MOTORS

1½ to 3 volts DC. Ideal for model boats, cars, planes, etc. Strong torque. Only

**65c. each or 10 for $4**

(Post 12c.)

### AIRCRAFT CLOCKS

Genuine Smith Eight Day Dualed movement, sweep second hand and start of trip indicator. Dash mountings. Ideal for car rallys.

$17.50. Post 74c

### "PLESSEY"

Producermatic 2" professional endless cartridge replay machines 2 track stereo with third cue track for machine control (auto-stop etc.). 600 OHM line level outputs. 240V AC operation. All silicone transistors 7½ I.P.S. 19" rack mounting. 60 Hz (240V) Model $50, 50 Hz (240V) Model $60. Ideal for tape idents, background music, etc. $1 cartage to rail. Freight payable at nearest attended railway station.

### TELEPHONE WIRE

1 mile twin (2 miles) genuine ex-Army Don 8 perfect condition $35 per drum $1 cartridge to rail freight payable at destination.

### PRISMATIC COMPASSES

Genuine ex-army Mk 3, liquid damped, as new $27.50. Post NSW 95c. Interstate $1.15.

### COLLINS TRANSCEIVERS

Auto tuned 100-150MHz. 10 channels.

**$65.00**

### AR7 RECEIVERS

WITH ONE COIL BOX $45.00

Complete with Power Supply and 5 Coil Boxes $115.00. Freight payable at nearest attended Rly. Stn.

### UNI-SELECTORS

25 bank 25 position $4 each. Post N.S.W. 45c. Interstate 65c.

### ADLER FREQUENCY METER

100KHz-20MHz **$95**

### 4 DIGIT RELAY COUNTERS

50 volt DC, suit slot car. Lap counters, etc

**$1.25** each Post 18c

### NIBBLING TOOL

Cuts sheet metal like a punch and die, trims, notches and cuts to any size or shape over 7 16-inch.

**ONLY $6.50**

Post 74c.

### NIFE CELLS

1.2 Volt, fully charged, 4in x 3in x 1in 4 AH.

**$1 each.**

Post N.S.W. 25c. Interstate 35c.

### BC221

Frequency Meters.

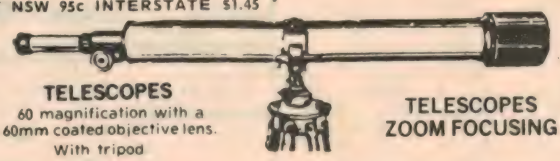
**$35.00**

P.M.G. TYPE KEY SWITCHES.

45c each. Post 24c.

25 x 30 $19.95 — 40 x 40 $28.95

POST NSW 95c INTERSTATE $1.45



### TELESCOPES

60 magnification with a 60mm coated objective lens.

With tripod

**$29.50**

As illustrated.

Postage $1.20. Interstate $1.45.

### WALKIE TALKIES

2-way radio, 7 transistor, PMG approved, set of 2 only $47.50

Post NSW $1.00 9 transistor $57.50
Interstate $1.20

### SMALL COMPUTER PANELS

3in x 2in containing 2 valves, qty. of resistors, etc.

**ONLY 75c.**

Post 24c.

### ELECTRONIC FREQUENCY COUNTER

Austronic type DFC-4 240V 50 cycle 0 100KHZ **$150**

### IMPELLER PUMPS

New gunmetal body, Stainless Steel Shaft. Neoprene Impeller. Up to 15ft. Lift, suitable for almost any type of liquid. Self priming. Ideal boat bilge pump, sullage drains, etc. Approx size 8" x 5".

| | |
|---|---|
| ⅜" | $19.95 |
| ½" | $22.75 |
| ¾" | $27.50 |

Post NSW $1.20. Int. $1.90

### A.W.A. B.F.O. TYPE R7077

1-800 CYCLES 1-13 K/CS. **$30.00**

### CONDENSER LENS

2½in DIAM. 2in FL $1.50 each. Or $2.50 per pair. Post 24c.

522 Tranceivers
100-150 M CS
**$35.00**

Cossor Double Beam Oscilloscope 1035 Tested

**$150**

# VALVES

## BRAND NEW

IN CARTONS

Special discount for quality

| | | | |
|---|---|---|---|
| 807 | $1.50 | CV850 | $1.50 |
| 6SN7GT | 95c | 1H6G | 50c |
| 5U4G | 95c | 832 | $5.00 |
| EF50 | 75c | 6AK5 | $1.50 |
| 5Y3 | $1.99 | 6X4 | $1.00 |
| 2 x 2 | 75c | VR65 | 50c |
| 6AG5 | 80c | VT4C | 75c |
| | | 80 | $1.25 |

Please add postage on all articles

### PARABOLIC REFLECTORS PYREX MIRROR

36" dia. Ideal solar radio optical experimenting also decorating purposes. $37.50. Sorry shop sales only.

### RADAR TRANSCEIVER

X BAND WITH KLYSTRON ETC. **$45.00**

### TRANSMITTERS ARC 49

100-165 M/CS **$25.00**

### TELESCOPES ZOOM FOCUSING

### CHASSIS PUNCH SET

Five sizes: ⅜-inch, ¾-inch, ⅞-inch, 1-inch and 1⅛-inches. With taper reamer.

**$14.50**

Post, $1.15

### SELSYN MOTORS MAGSLIP

Mk. II ..... $5.25 ea.

No. 19 TWO-WAY RADIOS.

Power supply, accessories, etc., $35.

### BINOCULARS

PRISMATIC. Coated Lenses. Brand new. Complete with case.

| | |
|---|---|
| 7 x 35 Wide Angle... | $34.50 |
| 8 x 40 Wide Angle... | $39.50 |
| 7 x 50 | $28.65 |
| 10 x 50 | $29.60 |
| 12 x 50 | $30.60 |
| 20 x 50 | $34.45 |

Post N.S.W. 95c; Interstate $1.45.

### 3000 TYPE RELAYS

P.M.G. 200 Ohms — 1,500 Ohm Coils. $1.25 each. Post 24c

### TOGGLE SWITCHES

Brand new, 3 amp, 240 volt. S.P., S.T. 50c each or 10 for $4.

Add postage.

Cintel Oscillator and Electronic Counter, type 388. $250.

SPECIAL lucky dip valve offer, 15 new valves in cartons for only $2.95. We haven't got time to sort them, so you reap the benefit.

Post 75c

### CONDENSER LENS

11½in diam. 11½FL 50c each

Postage 24c

### MINE DETECTORS

Ex A.M.F. Complete in wooden case. Ideal for plumbers, councils for locating buried pipes, etc. Freight payable at nearest attended railway station $39.00

### BATTERY CHARGERS BRAND NEW WITH METER

plugs into 240V power and gives both 6V and 12V DC output. 4 amps with hi, medium and low charges.

Dimensions, 9" x 5" x 5" $35 value only

**$27.50**

Post NSW $1.00 interstate $1.50

### SCOTCH BRAND RECORDING TAPES USA

EX ABC ¼" Polyester

2400ft. on 10½" reels $3.95

Post NSW 45c. Interstate 75c.

### SOLENOIDS

Plunger Type 12V 300MA. Suit electric camera control, miniature trains, radio, etc.

$2.50 Post 24c.

200 MA 24 volt, ¼in push movement. $2.50 Post 24c.

### ZOOM FOCUSING MICROSCOPE

Battery and mirror illuminated 900x magnification. Complete with dissecting kit slides etc. **$22.50**

Post NSW $1.00
Int. $1.25

### FIELD STRENGTH METERS

144 M/CS. **$12.50**

### TEN CHANNELS VHF TRANSCEIVER

Types TR 1934 100-125 MHz and TR1935 125-150 MHz. 28 volt DC operated AM single crystal locks both TX and RX on same channel complete with generator. **$33.00**

### RECORDING TAPES

TOP QUALITY, BRAND NEW

| | | Post |
|---|---|---|
| 3" x 150' | .75c | 12c |
| 3¼" x 600' | 1.75 | 13c |
| 5" x 900' | 2.20 | 13c |
| 5" x 1800' | 3.99 | 13c |
| 7" x 1200' | 3.25 | 24c |
| 7" x 2400' | 5.80 | 74c |
| 7" x 3600' | 6.99 | 74c |

### CASSETTE TAPES

C60 99c C90 $1.75 C120 $1.95

Post 13c.

| | |
|---|---|
| Crystal Earphone | 75c |
| Cassette head cleaners | $1.50 |
| Small Lapel Microphones, ea. Post 24c | $1.25 |

### AIRCRAFT MAGNETOS DELCO

Magnetos, new cond, 12 cyls, $15 ea. Post NSW $1.20, interstate $1.95.

### BYER 77 Mk. 1

Rack Mounting Tape Recorder ex A.B.C. 7½-15 ips. Full track tested $150.

Marconi Video Oscillator type TF885A 0-12 MHz $75.

### A.W.A. SIG GENERATOR

UHF 140-300 MHz $65.00

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# LISTENING TO THE WORLD

by Arthur Cushen, MBE

**A major reshuffle of the frequencies of European medium-wave stations is planned next year, when, for the first time in 26 years, a conference is to be held to try and reallocate channels to improve reception in Europe.**

Next year a conference is to be held to discuss the allocation of medium-wave frequencies in Europe. The numerous new stations, which have opened in Eastern Europe in the past few years have congested the band, and a complete revision of frequency allocations is now necessary.

The last time the frequencies in Europe were allocated, was back in 1947 at the conference in Copenhagen, Denmark, when the frequencies now in use, were allocated. This has now been outdated by the numerous new stations, and the increases in power. The interference in Europe after dark is severe.

There have been several suggestions to overcome the crowded band and two major changes are predicted. Firstly a change of channel spacing or separation in the medium-wave band, and secondly, a careful geographical rearrangement of stations operating on the same frequency. The spacing of stations is not standard throughout the world. In North America the Pacific and parts of Asia the stations are separated by 10kHz. In Europe and Africa, the station separation is 9kHz. Technical improvements in receiver design will allow the stations to operate closer together, and if a spacing of 8kHz were adopted, 136 channels would be available, providing many more frequencies than at present. The range of the stations not only dependson power, but also the frequency used. According to a report from Radio Nederland, the lower frequencies have a greater sky wave and therefore are more subject to interference from stations using the same frequency. It is presumed, that if the stations were located in the form of a triangle, about 2200 miles apart when using the higher frequencies, and 1300 miles on the lower frequencies, interference should not be present. A similar solution in Africa recently, is providing a satisfactory answer to the interference of stations using a common frequency on the medium-wave band.

### RADIO NEW ZEALAND

Broadcasting in New Zealand is to undergo substantial changes following the Labour Government intensions of setting up three Corporations, two would be concerned with television and the other with radio. The first television corporation would be based in Wellington and the second in Auckland. The radio services are to be extended, and it is expected that this section will be known as Radio New Zealand, which will be confusing to short-wave listeners, who already know Radio New Zealand as the country's external service.

The recommendations for the short-wave service include a power boost, and it is contemplated that two transmitters, each of at least 50kW, would be used in upgrading the external service. There would be greater use of the languages of the South Pacific, enabling further rebroadcasting in the area.

### NEW DX CLUB

A new DX Club was recently formed in Adelaide, known as the "Southern Cross" DX Club. For many years a group of enthusiasts have been meeting in Adelaide, and these informal meetings have done much to keep the hobby alive in South Australia. Two stalwarts were the late James Paris and Earn Suffock, who, with Rex Gillett, kept the hobby very much to the fore, in that area.

Recently plans were announced to broaden the scope of activities and the Southern Cross DX Club was formed. The group was established with 12 members, and the secretary is John Pickering of 23 Vinall Street, Dover Gardens, South Australia.

John Pickering started DXing in 1942, and joined the South Australian DX Club in 1945. He has always taken an interest in the hobby, becoming active in the last few years, and feels a necessity for a group to be established on a more permanent basis. At the present time, the Club is interested in expanding in South Australia, and readers requiring further information, should get in touch with John Pickering.

### RECENT VERIFICATIONS

PAPUA NEW GUINEA: A post card verification has been received from Radio Southern Highlands, which broadcasts from Mendi on 3275kHz. According to the verification, the station is operated by the Government of Papua New Guinea, at 0745-1100 GMT. The usual folder verification seems to have been withdrawn by the stations, pending the change over of broadcasting control.

HONDURAS: HRPL3, Radio Progreso confirms reception with a letter in Spanish, sent by the Engineer, Mr Jerry E. Tolle. The station operates on 4920kHz with a power of 20kW using the mailing address of Apartado 20, El Progreso, Yoro, Honduras.

INDIA: The All India Radio station at Imphal operates on 920kHz, using a power of 50kW. Reception is possible at 1530GMT when English news is broadcast. The verification letter was signed by R. Krishnan, Station Engineer.

ANGOLA: Voz de Angola has verified Bob Padula of Melbourne with a card showing a view of the beach at Luanda. The report was for reception on 6175kHz verification being received by airmail in six weeks.

CAMEROONS: According to ADXN Yaounde, Cameroons now verify with a yellow and green map card showing location of stations. The verification details were in French on the reverse side and confirmed reception on 4972kHz.

CHAD: A verification from Chad heard on 4904kHz, has been received by Ernie Moore of Brisbane. This card had three views with details on the reverse side in French. The verification took ten weeks to come to hand.

The Deutsche Welle relay station at Kigali in Rwanda, is now relaying the programs of Radio Canada for reception in Africa. During 1963 the Voice of Germany established this relay station which subsequently increased power to 250kW. In 1965, these facilities commenced operation, and since then, further high powered transmitters have been added.

Since September, Radio Canada programs have been relayed by Kigali on the following schedule:

| GMT | kHz |
|---|---|
| 0245-0330 | 7225 |
| 0245-0330 | 9565 |
| 0500-0545 | 9700 |
| 0500-0545 | 11905 |

### SWAZILAND RADIO

According to news from Colin Miller of Johannesburg Dr Paul E. Freed, President of the Trans World Radio, announced that plans are now finalised for the installation of a powerful missionary radio station, in the country of Swaziland, in the Southern part of Africa. Trans World Radio plans to install a medium-wave transmitter of either 250 or 400kW, together with four short-wave transmitters with a power of 30kW each. The delays which have attended the Swaziland project have now been resolved. The small staff having completed preliminary planning, will now be augmented, as the building program begins immediately. It is expected that the first transmitter will be on the air by the end of the year. Trans World Radio Swaziland will broadcast the Gospel, in the key languages of Southern Africa. The station will be situated in the East of the Country near the Mozambique border, in the Lowveld. Apparently, the site has good conductivity, and the signal is expected to have a good take-off.

### HLDA'S NEW SERVICE

Some weeks ago a powerful new voice on the medium-wave band was heard from the Far East Broadcasting Company, which took the air from Cheju Island. The transmitter has a power of 250kW and uses 1570kHz, being strategicly located, so that it can broadcast to China. The Cheju location is better than the previous FEBC station broadcasting to China from Okinawa. The station was recently silenced when Okinawa reverted to Japanese rule, and withdrew FEBC's licence for broadcasting into China. The Cheju Island station will also be $2\frac{1}{2}$ times more powerful than the Okinawa station. In its initial period of broadcasting, operation was only from 1030-1230GMT because of restrictions in the use of foreign languages. When this has been rectified by the Korean Government, full time operation will commence in languages other than Korean. The station confirms reception from its address in Korea, which is HLDA, PO Box 3939, IPO, Seoul, Korea.

### FLASHES FROM EVERYWHERE EUROPE

SWITZERLAND: The International Red Cross have advised that further tests will be carried out in November. On 27th November from 0945-1015GMT, on 21520kHz to India and Pakistan, on 17775 to Japan and China, on 11775 to New Zealand, and on 9590 to Australia. On 29th November from 0945-1015GMT in English and French on 17775kHz to East Africa, on 15305 to Nigeria, and on 15430 to Senegal and Zaire. Reports are verified by an attractive card, and should be sent to The International Committee of the Red Cross, Geneva, Switzerland.

FRANCE: THE ORTF, Paris has only programs in English directed to Africa, and the present schedule is:

| GMT | kHz | Area |
|---|---|---|
| 0515-0545 | 17730 | East Africa |
| 0515-0545 | 11735,9680, 7135 | West Africa |
| 0515-0545 | 15295, 9710, 6030 | Central & S. Africa |
| 1030-1115 | 17730 | East Africa |
| 1030-1115 | 21680, 15295 | Central & S Africa |

INTERNATIONAL WATERS: According to Sweden Calling Dxers, the Dutch Government have signed the Strasbourgh-treaty, which makes it illegal for offshore pirate stations to operate. This would effect Radio Veronica, Radio Nordsee International, Radio Caroline and Radio Atlantis, but the first two stations are understood to be seeking a licence from the Dutch Government for land based operation.

### AFRICA

SOMALI REPUBLIC: According to the World Bulletin, Radio Magadishu, no longer has an English program at 1730GMT. The station is heard with Swahili 1500-1530GMT, Afar 1530-1600, Arabic 1600-1630, Somali 1630-2000 close-down, all on 6095kHz.

NIGERIA: Lagos Nigeria has been heard by Ian Donaldson of Terang, Victoria at 0600GMT on 15185kHz. According to the latest schedule from Lagos, this transmission is beamed to Europe and the Mediterrancan, and is on the air 0530-0730GMT in English. A further frequency 7275kHz is beamed to the same area, while West Africa and the Middle East is served by 15120kHz. A further transmission in English from 1530-1700GMT is broadcast on the same frequencies, while from 1800-1930GMT a service to Europe, Middle East and South Africa is carried on 7275, 11925 and 1518kHz. The frequency of 11925kHz has been heard at 0600GMT, but is not listed in the latest schedule.

EGYPT: Radio Cairo has been heard in Arabic at 0600GMT on the frequency of 11630kHz. According to the latest schedule, this frequency is in use at 0100-0145 (French), 0145-0245 (Arabic), 0800-0000(Arabic). It would appear that the schedule has been extended and that the sign-on for the day is much earlier.

SOMALI REPUBLIC: According to the World Bulletin, Radio Mogadishu no longer has an English program at 1720GMT. The station is heard with Swahili 1500-1530GMT, Afar 1530-1600, Arabic 1600-1630, Somali 1630-2000 closedown, all transmissions on 6095kHz.

LESOTHO: According to the World Bulletin Radio, Lesotho has added a further thirty minutes to its daily schedule which is now 0400-2030 on 899 and 4800kHz.

Notes from readers should be sent to Arthur Cushen, 212 Earn Street, Invercargill, New Zealand. All times are GMT. Add 8 hours for WEST, 10 hours for EAST, and 12 hours for NZ, plus 1 hour if on daylight times.

# BOOKS & LITERATURE

## Amateur FM

**THE 2-METRE FM HANDBOOK — Using FM for Amateur Radio, by Ken W Sessions, First edition, Published by Tab Books, Blue Ridge Summit, Pa, USA, 1973. Soft covers, 217 x 138mm, 305pp, many circuits and diagrams. No 621 of a series. Price in Australia $7.40.**

If you want to know about 2-metre FM repeater operation, then this is the book for you. Written by an amateur for amateurs, the theory and practice of this type of communication is discussed in sufficient detail for the newcomer to be well informed on the subject. A number of suggestions are also provided for specific conditions of operation.

Since the book was written in USA, some of the subject matter is peculiar to operations in that country such as "The Autopatch." Nevertheless the information is all very useful and many ideas can be adapted to the local scene.

The book is divided into nine different parts with each part covering a number of chapters. Looking over the content of several of the parts will provide an insight to the wide range of material covered. As an example, Part I, entitled, "The Basic FM Repeater," consists of the following headings, FM repeaters — where they stand — National standards for repeater operation — Understanding the carrier operated repeater — Tone decoders for FM repeaters — How to control a repeater with tone-Improved repeater intelligibility — Effective techniques for minimising desensitisation — Solving intermod problems.

Part 2, entitled "Digital identification" consists of, Introduction — The WB6BFM Digital identifier — A Computer optimised digital identifier — WA0ZHT design data — The Curtis CW identifier.

Part 7, entitled "Build it yourself FM righs," covers a Pocket size VHF transmitter and receiver-Low cost portable transmitter for repeater use — UHF transmitter-UHF superregen receiver.

The list of titles for the nine parts is as follows: part — — The basic FM repeater; part 2 — Digital identification; part III — The autopatch; part IV — Tips and circuits for repeater users; part V — Ideal antennas for 2m FM; part VI-FM test equipment circuits; part VII-Build it yourself FM rigs; part VIII-Special repeater circuits; part IX — What the FM market holds. An index is included.

The review copy came from the local representatives of the publisher, Grenville Publishing Co Pty Ltd, who advise that copies should be available from all major bookstores. (F.J.S.)



## TV Repairs

**BEGINNER'S GUIDE TO TV REPAIRS, first edition 1971, by George Zwick. Published by Tab Books, Blue Ridge Summit, Pa, USA. No 563 of a series. Soft covers, 171pp, 218 x 138 mm, many pictures and illustrations. Price in Australia $4.95 softcovers, $8.70 hard back.**

The theme of this book, written in an elementary style, is to acquaint the average hobbyist and handyman with the workings of a TV receiver. It explains enough for the intelligent user to carry out routine maintenance and ensure that the receiver is operating at best performance. It avoids the complex tasks involving soldering irons, within the receiver, and the changing of picture tubes and such like practices requiring special skills.

Two chapters are devoted to an explanation of colour and how each section of a colour receiver operates. Details are also given on the various adjustments available for optimising the colour reception. The book refers of course to the American NTSC system, although much of the information can be applied to other systems. The last chapter covers troubleshooting of the colour sections.

Although the matter of ghosting, smearing, and so on, is mentioned in connection with antennas, much more could be said about antennas and their effects upon reception.

There are nine chapters with headings as follows: 1 The TV System — 2 How a TV Receiver Works — 3 Colour TV and How It Works — 4 The Colour Only Sections — 5 Introduction to Troubleshooting — 6 Operating Adjustments — 7 Preliminary Troubleshooting — 8 Troubleshooting Procedures — 9 Troubleshooting the Colour Section. A Glossary of seven pages is added for definitions and terms of reference plus an index.

The review copy came from Grenville Publishing Co Ltd of Sydney, who are the local agents for Tab Books. Supplies should be available from all major bookshops. (F.J.S.)

## Automotive Tune Ups

**USING ELECTRONIC TESTERS FOR AUTOMOTIVE TUNE-UP, by Albert Wanninger. First edition, published by Tab Books, Blue Ridge Summit, Pa, USA, 1972. Soft covers, 217 x 139mm, 256pp, many diagrams and pictures, No604 of a series. Price in Australia $6.15. (soft covers), $9.95 hardcovers.**

This book puts the spotlight on engine tune-up testers. Its aim is to acquaint the reader with the various kinds of automotive testers that are in common use by both the amateur and the full time professional mechanic.

A variety of testers are discussed, together with their uses and the procedure involved in applying them for tests. The results obtained and their interpretation are reviewed in some detail. The accent is on the use of test equipment rather than the repairs necessary to correct the faults displayed.

Some idea of the chapter content is obtained from the following headings: 1-Voltmeter and Ohmmeter tests; 2-Battery-Starter Tester; 3-Charging System Analyzers; 4-Tachometers and Dwell meters; 5-Timing Lights; 6-Ignition Advance Testers; 7-Ignition Testers; 8-Ignition Oscilloscopes; 9-Electronic Compression Testers; 10-Vacuum Gauges; 11-Exhaust Gas Analyzers; 12-Specialised Testers and Diagnostic Equipment.

Four appendices are included, a Tune-up Trouble Shooting Chart, a Tune-Up Specifications Reference, a Directory of Test Equipment manufacturers, and a list of International Symbols. A 7 page detailed glossary is also included, together with an index.

The review copy came from the local representative of the publisher, who advises that copies should be available at major bookstores. (F.J.S.)

## Transistor Data

**THE SEMICON INDEX VOLUME 1 — INTERNATIONAL TRANSISTOR DATA MANUAL — 1973 EDITION, compiled and published by Semicon Indexes Limited, Workingham, United Kingdom. Softcovers, 185 x 255mm, 355pp. Price in UK .5.25, elsewhere .6.70 (includes surface mail).**

A reference manual intended to provide comprehensive ready-to-hand information

on discrete circuit elements in the semiconductor field. It contains the essential parameters of some 18,000 transistors of international origin, and includes a comprehensive substitution guide for the 2N transistor series.

The manual is divided into 8 sections, each of them colour coded to assist in their individual location. The first two sections are relatively short. Section 1 gives a list of definitions, codes and symbols, whilst section 2 includes a list of manufacturers' names and addresses.

All transistors, including FET's, are arranged in alpha-numeric sequence irrespective of other classifications. A separate list of FET's under the appropriate column headings is to be found in Section 4. Each entry is on a single line and first identifies the device, followed by its characteristics and alternative manufacturers. In general, all characteristics are shown under common column headings to facilitate comparison.

CV type numbers are listed in Section 7 together with their basic characteristics and a list of possible substitutes. A drawing reference identifying terminations is included in Section 8. Section 5 on unijunction transistors has been omitted from this issue, but will be included in the next edition.

According to the publishers, the volume is being continuously revised as information is received and a completely updated edition will be published annually.

This book should be of considerable value to engineers and technicians, and certainly merits the consideration of anyone wishing to purchase a transistor data manual.

The review copy came direct from Semicon Indexes Ltd, 29 Denmark Street, Workingham, RG11 2AY, England, but presumably the book could be ordered by any local bookstore. (G.I.S.)

## Alarm systems

**INSTALLING AND SERVICING ELECTRONIC PROTECTIVE SYSTEMS, by Harvey Swearer. First edition, published by Tab Books No605, Blue Ridge Summit, Pa, USA, 1972. Soft covers, 136 x 214mm, 256pp, many illustrations. Price in Australia $6.15 (soft covers), $9.95 hard cover.**

The present upsurge of theft and break and entry reports should be sufficient to alert anyone to the need for some simple and foolproof intruder alarm devices on the home, car or business premises. The complexity of the device used would justifiably be proportional to the value of the goods to be safeguarded.

This book covers the subject from the ground floor up, describing in some detail the methods of detection with various systems. It offers suggestions on the installation problems and to a lesser degree their maintenance.

The range of equipment covered is quite extensive, from simple electromechanical devices to more sophisticated electronic surveillance systems. These involve sub sonic frequencies, audio-visual-seismic-vibration-stress detectors and proximity devices.

Eleven chapters are provided, with the content as follows: 1-Basic Alarm Systems; 2-Business Operations; 3-Sensors and Detectors; 4-Electro-mechanical Alarm Systems; 5-Photoelectric Alarms; 6-Ultrasonic Detection Systems; 7-Microwave Systems; 8-Proximity Alarm Systems; 9-Audio and Visual Alarms; 10-Seismic, Vibration and Stress Intrusion Systems; 11-Summary of Specialised Systems. Then follows a list of manufacturers and US suppliers of specialised equipment.

The book ends with a glossary of terms, a four page appendix of US Federal Crime Insurance Regulations and three pages of index.

The review copy came from Grenville publishing Co Pty Ltd, who advise that copies are available from all major bookstores. (FJS)

## Video techniques

**THE VIDEO HANDBOOK, published by Media Horizons, Inc, New York, 1972. Soft covers, 220 x 283 mm, 202pp, many illustrations. Price in USA $10.50.**

A reference manual for those using video equipment in business and industry, training and educational establishments, and similar non-broadcasting applications. It deals with both equipment and techniques, and is designed as a complete practical guide for the setting-up and day-to-day use of a video installation.

There are six basic sections. The first deals with facilities and equipment in broad terms, to guide in drawing up specifications. The next three sections deal with pre-production, production and post-production techniques, and are to serve as a reference for day-to-day operations. The fifth section then deals with distribution and presentation of programs, and considers the various recording and playback systems available. Finally the sixth section provides all manner of assorted reference data.

The material in the various sections is of somewhat uneven quality, and gives evidence of being assembled from a variety of sources — manufacturers' literature, magazine articles, etc. However, despite this it cannot be denied that the book as a whole contains a very large amount of useful practical information on video equipment and its effective use.

The review copy came from the Australian representatives of the publisher, Feffer and Simons, Inc, from whom bookstores could no doubt order supplies. (J.R.)

## Computer design

**DIGITAL SYSTEMS: HARDWARE ORGANISATION AND DESIGN, by F. J. Hill and G. R. Peterson. Published by John Wiley & Sons, Inc, New York, 1973. Hard covers, 158 x 236mm, 480pp, many diagrams. Price in Australia $17.95.**

A book written as a text for both electronic engineering students and computer science students, and dealing specifically with the design of computer hardware. It aims to involve the student in the actual process of designing computer sub-systems, in contrast with those books which basically do little more than review the operation of existing equipment.

There are 15 chapters, whose headings give a good idea of the material presented and its organisation: 1 — Introduction; 2 — Organisation and programming of a small computer; 3 — System components; 4 — Design conventions; 5 — Introduction to a hardware programming language (AHPL); 6 — Machine organisation and hardware programs; 7 — The control unit; 8 — Microprogramming; 9 — Intersystem communications; 10 — Interrupt and input / output; 11 — High speed addition; 12 — Multiplication and division; 13 — Floating-point arithmetic; 14 — Features of large, fast machines; 15 — Special purpose systems and special-purpose computers. The book ends with an appendix dealing with sophistications in control unit hardware, and a subject index.

The text is written in clear and concise language, and overall the book gives every indication of being a sound and comprehensive introduction to computer hardware design engineering. Even for those who will never actually be involved in computer design, it should be of considerable interest and value.

The review copy came from the local office of the publisher, but copies should be available from all major bookstores. (J.R.)

# INFORMATION CENTRE

**REGULATED POWER SUPPLY:** May I express my appreciation for your magazine being such a help to beginners such as myself. Having constructed the regulated 30V/1A DC Power supply (March 1973), I find there is a lot of background noise when connected to a 4½V National radio. Could you suggest causes and remedies? (J.B., Kambalda West, WA.)

Thank you for the kind remarks about the magazine. You give only a vague description of the trouble you are experiencing, however, and this makes it rather difficult to suggest causes and remedies. The most usual cause of this general sort of problem is power mains noise being coupled into the low-voltage supply wiring via stray capacitance in the power transformer. If this is the case, a significant improvement should be produced if you fit bypass capacitors of 0.1uF or larger (up to say 0.47uF), paper or plastic, from each side of the transformer secondary to the earthed chassis.

Another possible cause is a noisy zener diode, although this is not very likely. We assume, of course, that the receiver is not noisy when operating from batteries!

**SHORT WAVE DX RECEPTION:** I am a beginner and find your magazine very helpful. Can you tell me if the the converters in the April and June issues would receive DX? What type of aerial is best? and where will I find details of a receiver to tune the VHF bands of 118-136 MHz and 140-144MHz? (D.D., Ringwood, Vic.)

The two converters are potentially capable of receiving signals from any part of the world, given the right conditions. Their performance will, to a large extent, depend on the quality of the receiver with which they are used, and the aerial. We are planning some VHF converters, one of which was presented last month (August). Aerials for general short-wave coverage are very much a compromise, due to the need to cover a very wide range of frequencies and, ideally, to make the aerial resonant at any selected frequency. In practice almost any length of wire will provide results of some kind but a good compromise is the "Double Doublet" type, which we described in January 1968 (File No. 2/AE/21).

**ARGO RECORDS:** I have been interested in the record reviews in your magazine for many years and have purchased records on your recommendation. I have had difficulty, however, in buying records on the Argo label. Perhaps you could include a note indicating to other readers and distributors the source of these records. (R.S., Biloela, Qld.)

We understand that ARGO records are distributed by Scala Record Import Pty Ltd, 504 Pacific Highway, St Leonards, NSW 2065. Your local record store should be able to order the records from them.

**BITS AND PIECES:** Could you please tell me if "Electronics Australia" has ever described plans for a solid state oscilloscope, or has plans to do so in the near future? Also, is there any way to determine the nominal impedance of a loudspeaker from the DC resistance of its voice coil?

Incidentally, the 390 ohm 2W resistor in the regulator for the 10-plus-10 stereo amplifier (April 1969) dissipates about 4 watts after the thyristor has been triggered into conduction. I would suggest that a 5W type be used instead. (S.H., Revesby, NSW.)

Answering your questions in order, S.H., we have not published a solid state oscilloscope to date. We are considering a circuit design at present, but it is difficult to estimate when it might be ready for publication in view of component supply problems.

A rule of thumb which can be used to determine the nominal impedance of a loudspeaker is that the DC resistance is approximately two-thirds of the impedance, eg, a nominal 15 ohm loudspeaker has a DC resistance of between 10 and 12 ohms.

The 390 ohm 2W resistor in the 10-plus-10 does indeed dissipate more than 2 watts when the overload protection has been triggered, but normally the amplifier will not be left in this state for long periods; we therefore believe there is no real cause for concern. If the no-load voltage on the collector of the regulator transistor is above 45 volts, the 256 volt tap on the transformer primary should be used instead of 240 volt connection. This will have effect of reducing dissipation in the regulator when operating normally, and also in the 390 ohm resistor when the overload protection is operating.

**SEMICONDUCTOR GUIDE:** I noticed in an English magazine that the Motorola company had available a "Master Selection Guide" for their products. Could you tell me if it is available in Australia? (J.M., Gladstone. Qld)

Yes, it is J.M. — from Motorola Semiconductor Products, 37 Alexander St, Crows Nest, NSW.

**ADDRESS:** On page 11 of the July issue there is an article which mentions DC Industries Pty Ltd. Could you please tell me their address? (R.M., Mt Gravatt, Qld.)

Certainly, R.M. DC Industries are located at 19 Berry Street, North Sydney, 2060, and at 32 Smith Street, Collingwood, 3066.

**R/C SETS:** Could you please tell me if you have a circuit for a two or three channel radio control set (matching transmitter and receiver). I want one for which the parts are available in Australia. Also, do you have a 12 volt car battery charger. What is the cost of these circuits? (P.M., Casino, NSW).

The only radio control transmitter we have described is now out of date and hardly worth contemplating, P.M. It used valves which are now becoming scarce and in a short time they may be impossible to get. We described a single channel receiver in the February 1970 issue (File No. 3/MC/5).

We have described a number of battery chargers, the most recent being in August 1970 (2/BC/8), in the Reader Built It column, and an Automatic Charger in the October 1971 issue (2/BC/9). Reprints are available at 50 cents each.

**HI-FI TUNERS FOR PLAYMASTER AMPLIFIERS:** Having recently completed the Playmaster 118 Amplifier I am now interested in making a wide-band tuner to be used with it. Can you suggest a suitable type? Is it possible to align such tuners without the need for signal generators, oscilloscopes etc, by using the method described in the August issue for 1972? Furthermore, how should I connect a potentiometer between two speakers in my car to provide a balance control, and what resistance should it be? (P.McQ., Middle Brighton, Vic.)

We have described several wide band-tuners, the most suitable in your case is probably the Playmaster 138 Program Source, December 1972 (File No. 2 TU 33). Alignment procedure for this tuner is relatively simple and does not call for elaborate equipment. It is dealt with in detail in the text. We cannot help much in regard to the balance control you suggest. The speaker circuits are about the least desirable place to fit such a control since they present impedance matching requirments which could be quite difficult to satisfy. And, in certain circumstances, failure to satisfy them may create the risk of amplifier damage. Balance controls are normally fitted to the input circuits.

**SUPER AUTODIM:** I have built an extended version of your Autodim (July '71, File No. 2/PC/14) with ten masters and ten slaves, running across two phases and with a capacity of 200 amps, in theory. Each master and slave works well individually but when all run together there is a great deal of interaction. I have used pulse transformers to control the slaves and these transformers are shielded to prevent radiation. The unit is installed in a live theatre and while it is workable it is still not right. Can you make some suggestions to improve it? (R.B., Hastings, NZ.)

Clearly, you have taken our design far beyond the original scope, and we are not surprised that you have some interaction. We would first of all suggest that you use the more effective suppression circuit featured in the Varilight Mk 2 dimmer (April '73, 2/PC/18). Secondly, the bridge rectifiers should be supplied via separate cables from the switchboard so that they do not "see" the voltage drop due to the controlled loads. Similarly, the neutral for the two phases should not be common, otherwise interaction will be worsened.

You may also need to fit more extensive shielding between the Triac and trigger circuitry wiring of the various channels. The triggering pulses have quite a fast rise-time, and as a result there can be appreciable radiation from the wiring.

## HOW TO USE OUR INFORMATION SERVICES

As a service to readers "Electronics Australia" is able to offer: (1) Project reprints, metal work dyelines, photographs, printed wiring patterns and other filed material to do with constructional projects and (2). A strictly limited degree of assistance by mail or through the columns of the magazine. Details are set out below:

PROJECT REPRINTS: These cost 80c per issue-reprint. Thus, a project spread over three issues will cost $2.40. Reprints are available for all projects, but no material can be supplied additional to that already published. Reprints can be supplied more speedily if they are positively identified and not accompanied by techical queries. Material not on file can normal be supplied in photostat form at 40c per page.

SUBSCRIPTIONS, BINDERS, HANDBOOKS etc: These are handled by separate departments. For fastest service, send separate orders to the departments concerned.

PHOTOGRAPHS, METAL WORK DRAWINGS: Original photographs are available for most projects, Price: $1 for 6in x 8in glossy print. Metal work dyelines are available for most projects. Price: $1. These show dimensions and positions of holes and cut-outs, but give no wiring details.

PRINTED WIRING PATTERNS: We can supply transparencies, actual size, positive or negative, as specified. Price: 80c. We do NOT deal in manufactured boards. These are available from advertisers.

BACK NUMBERS: As available. On issues up to six months, face value. Seven months to 12 months, face value plus 5c. Thirteen months or older, face value plus 10c. Postage and packing, 30c per issue extra. Please indicate if a PROJECT REPRINT may be substituted if the complete issue is not available.

REPLIES BY POST: These are provided to assist readers encountering problems in the construction of our projects published within the last two years. Note, particularly, that we cannot provide lengthy answers, or undertake special research or modifications to basic designs. Charge: 50c. Inclusion of an additional fee does not entitle correspondents to special consideration.

OTHER QUERIES: Technical queries outside the scope of "Replies by Post" may be submitted without fee and may be answered in the magazine at the discretion of the Editor. Technical queries will not be answered by interview or telephone.

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ADDRESS: All requests for data and information should be directed to the Assistant Editor, "Electronics Australia", Box 157, Beaconsfield 2015.

(8/73)

**PHASE DIFFERENCES:** I noticed in your article on Omnidirectional Speaker Systems in the June issue that the diagram shows the tweeter connected in opposite phase to the woofer. The diagram with the crossover I bought from Pre-Pak Electronics (as suggested in the parts list) shows the other (normal?) connections. Which is correct? Also, what would be a good substitute for the woofer as everyone I approached seems to be out of stock. (W.C., Marrickville, NSW).

The article is correct. The reverse connection is to allow for phase differences set up by the crossover network. (See 2nd par, column 1 page 61 of that issue). The system was designed around the C80, and this should be used if the full performance is to be achieved. We suggest that you get in touch with Pressey Rola in Sydney (72 0133) and see if they can advise who might have stocks.

**WOOD OR METAL CABINETS?:** I am a beginner and intend building the "Plessey" 3 x 3 amplifier as a free-standing unit. I would like to use a wooden cabinet but you always use metal. Why is this? (L.W., Parkes, NSW)

Most constructors prefer to buy their chassis, panel and cabinet ready made, in which circumstances a metal cabinet is normally cheaper than a wooden one. Also, since wood is a good deal thicker, a metal cabinet is significantly smaller than a wooden one with the same internal dimensions. For the home constructor the wooden cabinet may be a better proposition, however, since the material is relatively cheap and labour costs are not a problem. In some cases metal cabinets have the advantage that they provide a shield against electrostatic fields as produced by power mains, strong local transmitters, etc. If a unit performs well without any cabinet, then a wooden unit will be quite satisfactory. In most cases this would be so.

If your amplifier does appear to be unduly sensitive to external fields when housed in a wooden cabinet, you could try the idea used by some TV receiver manufacturers of lining the cabinet with metal cooking foil. If this is connected to the earth amplifier chassis, it should offer a useful measure of shielding.

**PHOTOELECTRIC CARTRIDGE:** Reference was made in the May 1971 issue to a photoelectric cartridge made by A. Bernard Smith Laboratories. I would appreciate more information about this company. (John Sears, no address. Letter postmarked Melbourne.)

The article refered to was a reprint from the American publication "High Fidelity." We have no access to any further information.

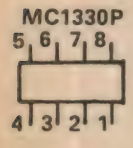
**1965 CRO:** As a club, we recently built the 1966 VTVM and we were very pleased when it worked first time. Another club project we are planning is the Standard Audio Oscilloscope of August 1965. We have all the parts except the cathode ray tube, the DG7-32 / 01. This is an expensive item and we have to work on a very limited budget, as most of our members are about 15 years old. We wondered whether any of your readers might be able to supply such a tube, or one like it. All our members thank you and your staff for an excellent magazine. (Peter Walsham, 50 Princes St, Pukekome, New Zealand.)

Thank you for your kind remarks about the magazine Peter, and we are glad to learn that you were so successful with the VTVM. We have no way of knowing whether any reader can help you with the cathode ray tube, but we have published your full name and address. If any reader can help, he should contact you directly. Good luck.

## NOTES & ERRATA

POWERPAC (July 1973, File No 2 / PS / 32): On both circuit and wiring diagram, the 220 ohm and 1k resistors are transposed. In addition, some portable radios have been found to be unstable when operated by the Powerpac. We suggest connecting a .047uF ceramic capacitor across the supply leads, inside the radio. This compensates for the inductance of the supply leads.

HOMODYNE TUNER (July 1973, File 2 / TU / 36): The pin numbers on the CA3028A and MC 1330P, IC's Fig 6-p35, are unnumbered. The accompanying drawings indicate the pin numbers, viewed from the underside of the IC's.





PLAYMASTER 137 LOW COST STEREO (March 1973, File No 1 / SA / 41): The width of the metal case is 9-¾ inches, not 4-¾ inches as shown in the text on page 39.

LSI DIGITAL CLOCK (September & October 1973, File No 7 / CL / 12): The type number of the A&R transformer is PT 9343 not 7343. NS Electronics distributors advise that they will have other equivalent transformers available.

## Wind for organs from p23

Two further points may be of interest. This writer's "Full Organ" switch has two change-over sets. One selects either the rotary pots or the drawbars, the other selects either a 3.8 V pilot (Full Organ on) for the rotary pots or disables the vibrato. The choice is thus a Swell Organ with vibrato available or an enclosed Great Organ — two quite different organs in one manual!

The other point is that BC108s are now competitive in price with disposal germanium transistors. They will operate in the February, 1969 circuit with the diodes reversed, 9 volt positive supply rail and a hold-off negative rail derived by half-wave rectification of one side of the centre-tapped valve heater line.

## DIGI-METER from page 33

to measure a voltage in a low resistance circuit, (say less than about 10k), the effect will be very small, and can generally be neglected.

For measurements in higher resistance circuits, the only way of correcting for the error produced is to first make the measurement, then simulate the resistance of the circuit by connecting a resistor of similar value across the Digi-Meter input terminals. The residual reading produced is then subtracted from the original reading, algebraically as before, to obtain the corrected reading.

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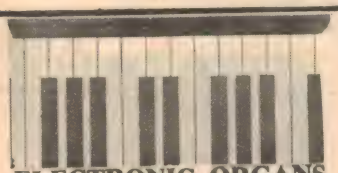

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A.C.E. Radio Pty Ltd, 136 Victoria Rd, Marrickville, 2048. Phone 51 7008.

John Carr Pty Ltd, 405 Sussex St, Sydney (PO Box K39, Haymarket 2000). Phone 211 5077.

Edge Electrix, 25A Burwood Rd, Burwood 2134. Phone 747 2931.

Dick Smith Electronics Pty Ltd, 162 Pacific Hwy, Gore Hill, 2065. Phone 439 5311.

Kitsets Australia (Sydney) Pty Ltd, 400 Kent St, Sydney and 1st Floor, 21 Oaks Ave, Dee Why (PO Box 176, Dee Why 2099). Phone 29 1005, 982 7500.

MS Components, 95-97 Regent St, Redfern, 2016. Phone 69 5922.

National Radio Supplies, 332 Parramatta Rd, Stanmore, 2048. Phone 56 7398.

Pre-Pak Electronics Pty Ltd, 718 Parramatta Rd, Croydon, 2132. Phone 797 6144.

Radio Despatch Service, 869 George St, Sydney 2000. Phone 211 0816.

Radio House Pty Ltd, 306-308 Pitt St and 760 George St, Sydney 2000. Phone 61 3832, 211 0171.

RCS Radio Pty Ltd, 651 Forest Rd, Bexley 2207. Phone 587 3491.

Wardrop and Carroll Fabrications Pty Ltd, Box 330, Caringbah, 2229. Phone 525 5222.

### VICTORIA

E.D. & E. Sales Pty Ltd, 118 Lonsdale St, Melbourne, 3000. Phone 662 3506.

Imported Components, PO Box 1683P, Melbourne 3001.

Kitsets Australia (Vic)Pty Ltd, 271 Bridge Rd, Richmond. Phone 42 4651.

J. H. Magrath, 208 Little Lonsdale St, Melbourne, 3000. Phone 663 3731.

Radio Parts Pty Ltd, 562 Spencer St, Melbourne 3000. Phone 329 7888.

### SOUTH AUSTRALIA

Gerard & Goodman Pte Ltd, 192 Rundle St, Adelaide, 5000. Phone 23 2222.

Kitsets Australia (SA), 50 Grenfell St, Adelaide, 5000. Phone 87 5505.

### QUEENSLAND

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